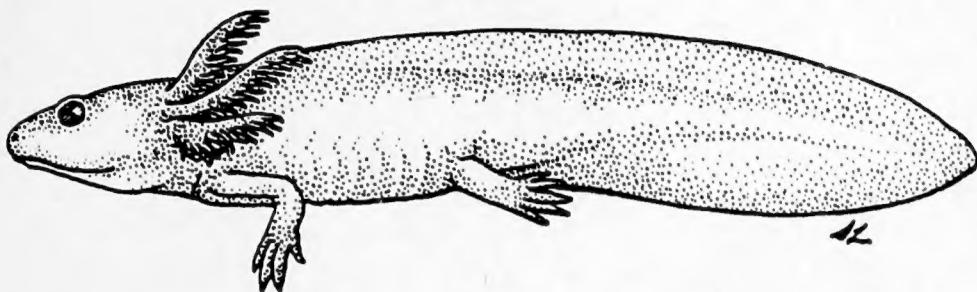


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LARVAL AND NEOTENIC SALAMANDER BIOLOGY

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## INTRODUCTION

This bibliography is the caudate sequel to the tadpole bibliography of Altig and Christensen (1976) published in this series. Emphasis was placed on reproductive biology, development, behavior and organismal physiology of aquatic and direct-development larvae and "neotenic" adults as well as citations concerning breeding biology, eggs and postmetamorphic juveniles. Abstracts, theses, dissertations, text books and species descriptions were omitted.

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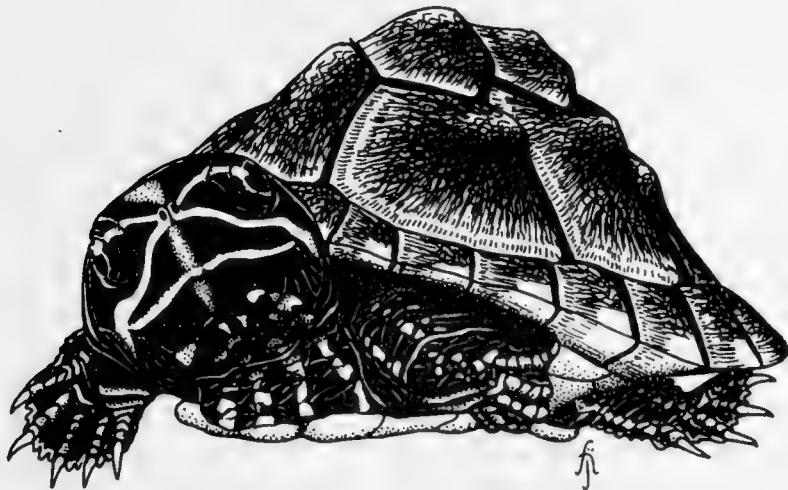
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A BIBLIOGRAPHY TO THE MUD AND MUSK TURTLE FAMILY KINOSTERNIDAE



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## Introduction

This bibliography is an outgrowth of nine years of research on the New World mud and musk turtles of the family Kinosternidae (genera Kinosternon, Sternotherus, Claudius, and Staurotypus). It is hoped that its availability will stimulate additional interest in this diverse New World turtle family. The bibliography is very thorough for all but one of the approximately 23 recognized species (see below). The weakest literature coverage is for the species Sternotherus odoratus which, because it is so wide ranging and extremely common, has been the subject of studies in nearly all fields of science. Many references for S. odoratus, at least, have no doubt gone unnoticed by us; however, it approaches completeness for the other forms. We would appreciate being made aware of any overlooked references.

A list of the currently recognized genera, species, and subspecies on which this bibliography is based follows:

### Family Kinosternidae

#### Subfamily Staurotypinae

Claudius angustatus

Staurotypus salvinii

Staurotypus triporcatus

#### Subfamily Kinosterninae

Kinosternon acutum

Kinosternon alamosae

Kinosternon angustipons

Kinosternon baurii

Kinosternon creaseri

Kinosternon dunni

Kinosternon flavescens flavescens

Kinosternon flavescens durangoense

Kinosternon flavescens spooneri

Kinosternon flavescens stejnegeri

Kinosternon herrerae

Kinosternon hirtipes hirtipes

Kinosternon hirtipes murrayi

Kinosternon integrum

Kinosternon leucostomum leucostomum

Kinosternon leucostomum postinguinale

Kinosternon scorpioides scorpioides

Kinosternon scorpioides abaxillare

Kinosternon scorpioides albogulare

Kinosternon scorpioides carajasensis

Kinosternon scorpioides cruentatum

Kinosternon scorpioides pachyurum

Kinosternon scorpioides seriei

Kinosternon sonoriense

Kinosternon subrubrum subrubrum

Kinosternon subrubrum hippocrepis  
Kinosternon subrubrum steindachneri  
Sternotherus carinatus  
Sternotherus depressus  
Sternotherus minor minor  
Sternotherus minor peltifer  
Sternotherus odoratus

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A BIBLIOGRAPHY OF ENDANGERED AND THREATENED AMPHIBIANS AND  
REPTILES IN THE UNITED STATES AND ITS TERRITORIES

(CONSERVATION, DISTRIBUTION, NATURAL HISTORY, STATUS)

SUPPLEMENT

C. KENNETH DODD, JR.

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This bibliography is a supplement to "A Bibliography of Endangered and Threatened Amphibians and Reptiles in the United States and its Territories" issued as Smithsonian Herpetological Information Service No. 46. Additional references to those species listed in the introduction to this publication are included, as well as references to two species, the Monito gecko (Sphaerodactylus micropithecus) and Wyoming toad (Bufo hemiophrys baxteri), which have been incorporated into current Program Advices of the U.S. Fish and Wildlife Service for listing or proposal to the U.S. List of Endangered and Threatened Wildlife in fiscal year 1981. It should be also noted that references to two species occurring within U.S. territories, Epicrates monensis granti and Crocodylus porosus, were included in S.H.I.S. No. 46 and are included in this supplement, even though both names were omitted from the list of species covered in the original bibliography. Although no future bibliographies of this nature are planned, updated lists of references dealing with federally protected or proposed species of amphibians and reptiles may be obtained from the U.S. Fish and Wildlife Service. Finally it should be noted that copies of all unpublished reports cited both in S.H.I.S. No. 46 and this supplement have been deposited in the library of the Division of Reptiles and Amphibians at the Smithsonian Institution.

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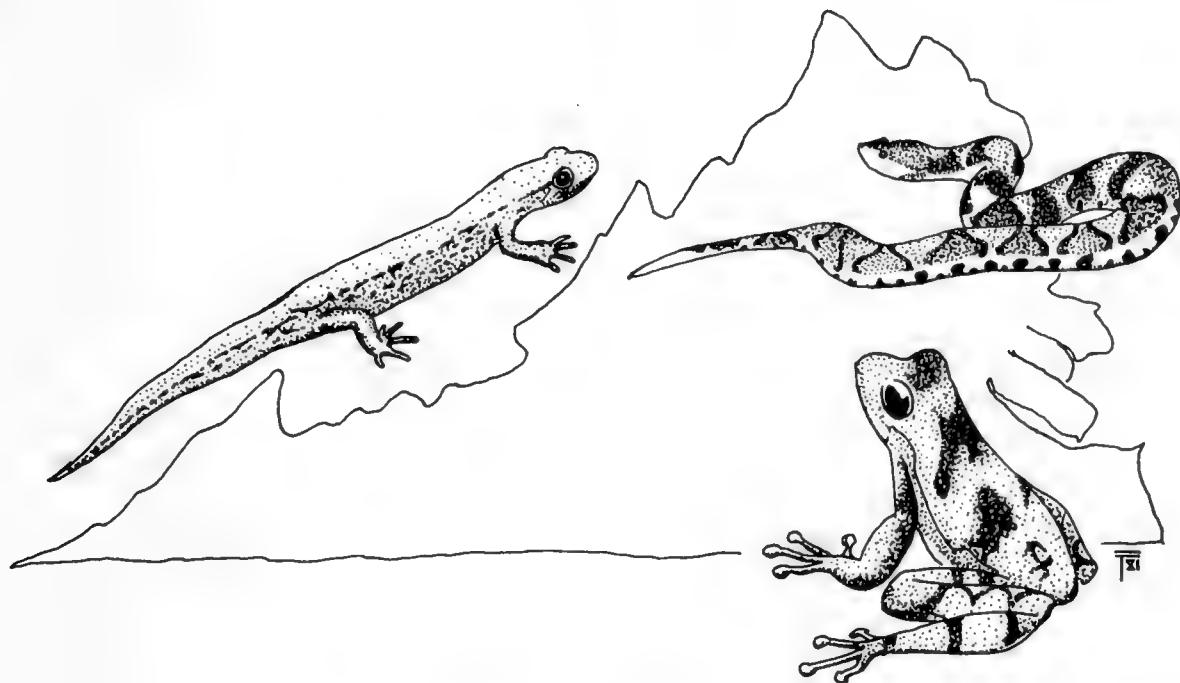
## Errata for S.H.I.S. No. 46

- p. 6 Add an s to turtle in Cahn (1937); The turtles of Illinois.
- p. 7 Campbell (1975) should read: Campbell, H. J., not H. W.
- p. 15 Gosselink and Hebrard (1978) should read:  
Gosselink, J. G. and J. J. Hebrard. 1979. Threatened, endangered, and extinct species in the Chenier Plain. pp. 393-415 In: J. W. Daly, Jr., D. D. Culley, Jr., R. E. Turner and A. J. Mumphrey, Jr. (eds.), Proc. Third Coastal Marsh and Estuary Manag. Symp., L.S.U. Div. Continuing Education, Baton Rouge, LA.
- p. 17 Hirth (1978) should read: A model for the evolution . . . .
- p. 34 Zwinenberg (1977) should read: Kemp's ridley . . . .
- p. 35 All references to Chabreck should be: Chabreck, R. H., not R. R.



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A BIBLIOGRAPHY OF VIRGINIA AMPHIBIANS AND REPTILES



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## Introduction

This bibliography had its inception in 1974. Titles and information were collected from the widely scattered sources through 1980. Literature concerning Virginia's amphibians and reptiles published after 1980 is not included. Also not included are dissertations, theses, newspaper articles and the like. Each citation is numbered and cross-indexed by species. Some papers undoubtedly have been overlooked, and I would appreciate being made aware of these.

## Acknowledgements

This bibliography could not have been compiled without the help of several libraries and their librarians. I am grateful to the staff of the following institutions for various forms of assistance: Arizona State University, National Museum of Natural History, University of Richmond and University of Tennessee. My wife, Wendy, aided in the search and compilation of many references. I am grateful to Susan M. Johnson for typing the manuscript. Frank H. Daniel provided the cover illustration.

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James A. Peters: A Biographical Sketch

(1922-1972)

Jim was a towering presence in mid-twentieth century herpetology. His six foot four inch lanky frame was a standout in any herpetological gathering throughout the forties and fifties, and only with the appearance of the larger and hairier herp students of the sixties did he merge back into the crowd. If not seen, he was still heard.

Jim delighted in playing the devil's advocate, and, while he held many opinions firmly, he was likely to take the opposite position just to keep a verbal duel alive. It is difficult not to take your opponent's opinions seriously when he towers over you, booms out his replies, and glares at you through bottle-bottomed lenses -- that was Jim.

Jim was born in Iowa, but spent most of his growing years in southern Illinois. He was the son of a small-town doctor, and apparently tried to keep his father busy by challenging his pals to feats of derring-do. In one such challenge, Phil Smith was performing aerial acrobatics on an overhanging tree limb. Phil spun, slipped, and fell to the sidewalk below. The landing was on three or more points, and one of the points, an arm, broke. Jim reassured Phil that all would be set right, because his dad was a doctor and could fix anything. The arm was repaired, and Jim later received a stinging reminder that his father did not desire Jim's assistance in producing patients.

His life-long interest in snakes grew out of his friendship with Phil. Phil and his cronies spent each spring and summer scouring the surrounding fields, woods, and river bottoms for snakes and other scaly creatures. The uncommon or unusual ones were brought home and installed in Phil's menagerie, an old shed. In the mid-thirties, the Peters' family moved into a house a half block away, and Jim became a regular visitor. Soon he was an avid collector and was likely trying to outdo his snake-hunter friends.

By high school, Jim had gained local fame as an expert on snakes. His reputation garnered him the opportunity to take his snake show on the road. Thus, Jim joined the carnival circuit and spent the latter part of one summer traveling from county fair to county fair. His snake show was one of the few free items on the midway, a state-supported show aiming to educate as well as entertain. Certainly it remained a fondly remembered summer, for Jim delighted in demonstrating to his children his ability to read the cryptic carny road signs posted each summer along the carnival routes. Likely, some of his

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footnote: I have tried not to duplicate information previously published about J.A. Peters. Further details may be found in The Washington Post obituary (Thursday, Dec. 21, 1972), Copeia 1973(2):388-390, and HISI News-Journal 1(6):187-188.

public speaking skills developed that summer and, if they occasionally showed a bit of the sideshow barker, we should not have been surprised.

As a high school student, Jim attended his first ASIH meeting in 1939. Even as a teenager, Jim was not bashful. I am certain that there was only a momentary pause before he introduced himself to the professional herpetologists and joined in the herpetological conversations. The favorable impression of this first meeting in Chicago was long lasting, for he devoted much time and energy to the society throughout his entire professional career. Whether serving as its business secretary, a governor, or committee member, he strove to improve the society, and was honored to be its president for the 1970-71 term. A fortunate happenstance, for his contributions would be lost to the society soon thereafter.

He had begun college in Illinois when the United States entered WW II. He joined the air force and spent the war years in active service. His eyesight was too poor to pilot planes, but he was right up front as a radio operator. He served in the Asian theatre flying supplies "over the hump" from India to Burma and transporting planes across SW Asia and North Africa for their periodic maintenance. His tour of duty in these areas allowed him to sample the herpetofauna of Africa and Asia and reinforced his desire to become a professional herpetologist.

With the end of the war, he returned to his studies, not in Illinois but at the University of Michigan. His Michigan sojourn lasted seven years, from 1945 to 1952, and encompassed both his undergraduate and graduate training. It was a period of intense herpetological growth and maturation for him. He early captured the highly-desirous research assistantship in the reptile section of the Museum of Zoology and held it for his entire graduate tenure. Here, he learned his curatorial skills and inventoried the herpetological type collection. Here also, he began his first in-depth studies of reptilian taxonomy under the tutelage of Norman Hartweg and was introduced to the Latin American herpetofauna. The museum mammalogists were collecting in Mexico, and Jim accompanied them in the summer of 1949 and 1950. Like other herpetologists who have accompanied mammalogists in the field, Jim complained that the best herp collecting times were spent riding to new collecting localities.

Jim began his teaching career at Brown University in 1952. The Brown years must have been frustrating ones, for he reminisced little about them. They were not, however, unproductive years, for he completed his dipsadine research, collated the "Classic Papers in Genetics," and compiled his "Dictionary of Herpetology." During this time, his research interest turned to South America, particularly Ecuador. I suspect this was in response to the superabundance of researchers concentrating on the Mexican herpetofauna and his desire to work in a less herpetologically trampled area. His Fulbright lectureship at the Universidad Central de Ecuador (1958-1959) ended the Brown years and entrenched his interest in Ecuadorian and South American herpetology. He was to return several more times to Ecuador (1962, 1966, 1969).

Every free moment in Ecuador was spent in the field. He made trips to isolated villages and would rent space at the local cabarets. While the evening crowd was making merry, Jim would be out collecting frogs and other critters. He would return as the revelry broke up, often to make his bed on a bench or behind the bar. Such behavior was not unexpected from a crazy gringo who chased snakes and other creepy things. Here also he began transect studies by traveling the supply trails on mule or horseback. Once he was accompanied by the unlikely pair of E.H. Taylor and C.F. Walker. He recalled stopping after several days of collecting, and Ed finally stopping his frantic collecting long enough to reconstruct data and tie tags on his specimens.

Upon returning stateside, he had a brief stay at the University of Southern Illinois before assuming his new position at San Fernando Valley State College. San Fernando provided him more time for research and a core of students interested in herpetology. However, his life's goal was to work in a museum, and when he was offered a curatorship at the National Museum, he grabbed it even though it meant a salary cut.

He arrived at the museum in time to prepare for the move from the cramped quarters in the central building to the spacious collection range in the just-completed west wing. No more would the collection have to be arranged by bottle size; now the specimens could be placed in taxonomic order. The collection was moved cafeteria-style. Everyone participated. The mover would take a set of cards from the species file, search through the old range, find specimens of his species scattered here and there, and then carry the completed set to the new range. With more than 200,000 specimens, the move was arduous, but it was rewarding to be able to go to one shelf and find all the specimens of a species together.

The museum years were good ones for Jim. He was able to extend his research and organizational energies in many directions. Latin American herpetology and computer storage and analysis of biological data always remained high in his active research. Jim had first used the computer to statistically analyze his dipsadine data at Michigan, but his interest blossomed in the late 60's with the advent of time-sharing computers. While statistical computation was useful, he was attracted to the computer's potential for the storage and retrieval of taxonomic and museum data, and their transmission and exchange through a museum network of time-share computers. This interest led to his establishment of MUDPIE -- an acronym for Museum and University Data, Program and Information Exchange and a typical example of his delight in word play and puns -- in order to share his ideas and interest with others. He became engrossed in developing interactive programs for the identification of taxonomic specimens. His joy was an interactive program that permitted museum visitors to a special reptile exhibit to ask questions about reptiles. Every afternoon, he would review the questions asked that day and add additional data to make the "machine" smarter. By the end of the exhibit's stay, few visitors could stump the machine.

A fortuitous remark at an international conference permitted the establishment of the Neotropical Squamata project. Jim's compilation instinct had lead to the growth of a small file/catalog on neotropical snakes and lizards.

It would have likely remained a personal file if Francois Bourli  re had not mentioned to Secretary S.D. Ripley that ecologists and conservationists needed a complete taxonomic guide and checklist to neotropical reptiles. Upon his return from the conference, Ripley queried Jim about the feasibility of such a guide and the project was born with the Secretary's support. The groundwork was laid; Roberto Donoso-Barros and Braulio Orejas-Miranda arrived to be immediately set to work. Jim was an unceasing, but congenial, taskmaster and after a year the bulk of compilation and cross-checking was completed. Roberto and Braulio returned home in the fall of 1968, but Jim continued to refine the checklist for another year before it went to the press, a monument to the loving effort of these three men.

With the catalog finished, Jim returned to his systematic herpetology and computer technology projects. His time was short, although he didn't realize it. He was busy finishing up many partially completed projects so he could return to his favorite research animals, snakes. Two snake projects -- Dendrophidion and a typhlopoid checklist had been begun but laid aside. He was never to complete them. The nagging stomach ache of 1971 continued into 1972 and, in spite of intense medical examinations, only when the cancer laid him low was the cause discovered -- much, much too late.

George Zug  
December 1980

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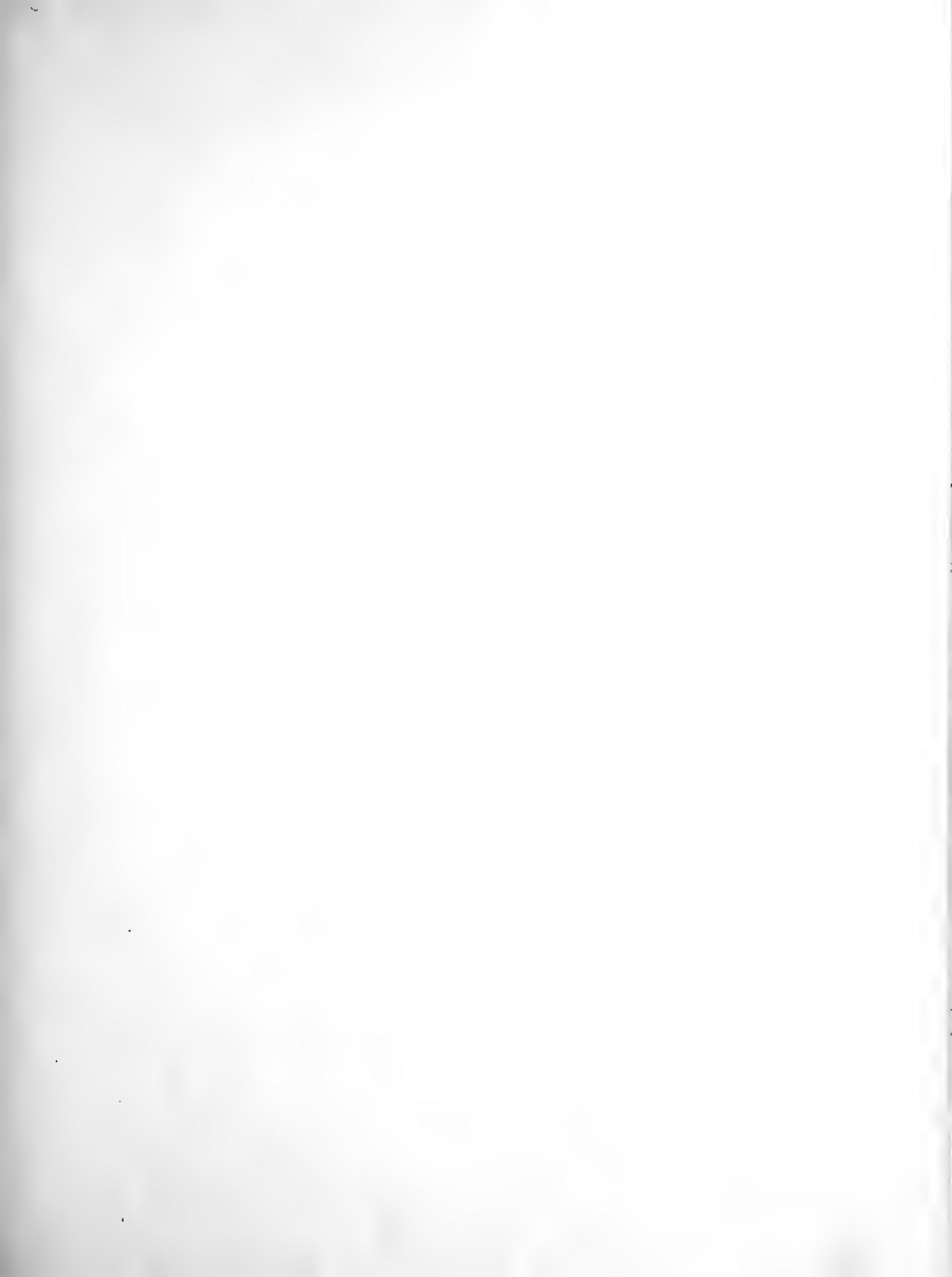
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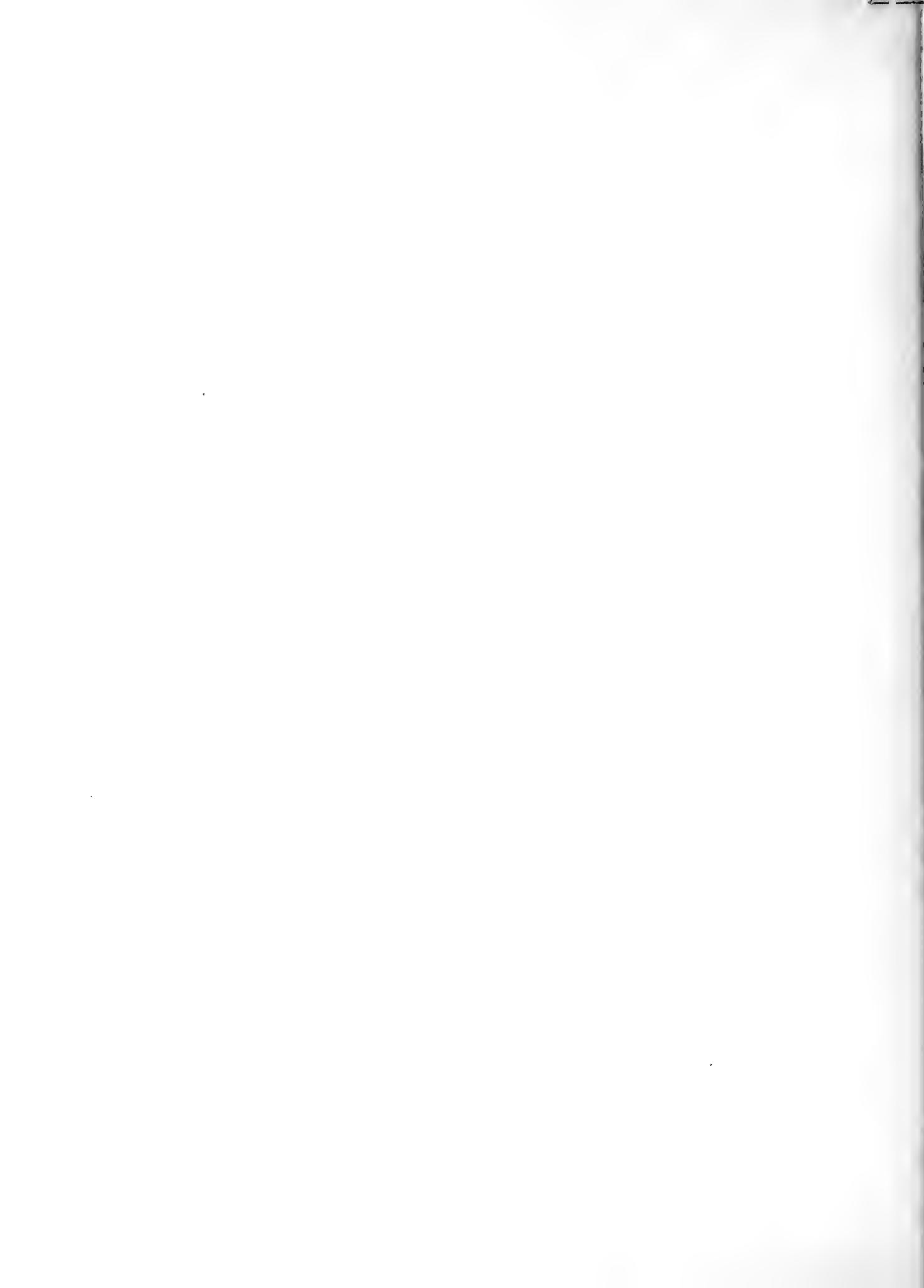
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FIELD BODY TEMPERATURES  
OF  
TROPICAL AND TEMPERATE ZONE SALAMANDERS

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RRADIES

## INTRODUCTION

This report presents field body temperatures of salamanders, and summarizes previous reports of field body temperatures in the literature. In it we extend and update a similar survey (Brattstrom, 1963), which has proven invaluable in studies of amphibian thermobiology.

Table 1 presents temperature records for salamanders. Each record represents a salamander or series of salamanders measured at the indicated locality and usually at the same time of day. Also included when available is information on time of year, locality, elevation, and microhabitat. Temperatures without literature references were taken by us. We measured the temperature of the substrate immediately adjacent to newly discovered salamanders. Bogert (1952) has shown that substrate temperatures measured in this manner are generally equivalent to salamander body temperatures. All temperatures of tropical ambystomatids are for aquatic salamanders and larvae.

In Table 1 we include only those values from the literature that were gathered with similar techniques. Reports equating salamander body temperatures with air temperature or weather bureau records are not included. In most cases we have retained the taxonomic designation employed by the original source.

Table 2 summarizes annual variation in body temperature that might be experienced by salamanders in a single population. Because body temperatures of tropical salamanders vary with elevation (Feder and Lynch, 1982), we include only species for which winter and summer records are available at the same elevation. Similarly, we report on only those temperate species for which winter and summer records are available for comparable climates.

Table 3 reports maximum and minimum temperatures for each species. Unlike in Table 2, these temperatures often are not for single populations and may represent extremes of species ranges.

These data are valuable in several respects. In designing experiments, biophysical modelling, calculation of energy budgets, etc., it is important to know what temperatures an animal normally experiences in the field. Also, exceptional species that experience unusual thermal regimes can be identified only when the 'normal' pattern is known. Furthermore, these data are obviously significant in understanding the ecological and thermal relations of amphibians; the data form the basis of an analysis of field body temperatures of salamanders (Feder and Lynch, 1982) with this goal in mind. [Values in Table 1 gathered too late to be incorporated in the above study and in Tables 2-3 are designated by '\*\*\*'.]

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TABLE 1. FIELD BODY TEMPERATURE RECORDS FOR NEOTROPICAL AND TEMPERATE ZONE SALAMANDERS.

Each record is for a salamander or series of salamanders collected at the indicated locality and usually at the same time of day. All temperatures are reported in degrees Celsius. Key to symbols and abbreviations: \*\* = Data gathered too late to be included in the analysis of Feder and Lynch (1982) or in Tables 2 or 3; n = Sample size of each series of salamanders; Gua = Guatemala; Mex = Mexico; Chis = Chiapas; Ver = Veracruz; Mich = Michoacan; DF = District Federal; Jal = Jalisco; Chih = Chihuahua; SLP = San Luis Potosi; Ibid = Identical to previous record except as indicated; SM trans = San Marcos transect, area described by Wake and Lynch (1976).

N. MEAN SD RANGE SPECIES DATE, LOCALITY, ELEVATION, ETC.

## NEOTROPICAL SALAMANDERS

## A. PLETHODONTIDS

001	15.0		<u>Bolitoglossa adspersa</u>	Bogota, Colombia 2650 M	Stebbins and Hendrickson (1959)
001	11.8	11.8-11.8	<u>Bolitoglossa compacta</u>	Aug 75 Cerro Resingo, Chiriqui, Panama 2700 M	Wet forest under log
003	21.8	1.2	20.0-22.4	<u>Bolitoglossa Dunnii</u>	Aug 75 Mts W San Pedro Sula, Honduras 1550 M Bromeliad on trees in meadow
002	15.6	1.3	14.6-16.5	<u>Bolitoglossa engelhardti</u>	Aug-Sept 72 San Marcos transect, Gua. 2090 M Bromeliad in wet forest
020	15.7	2.2	11.6-19.4	<u>Bolitoglossa engelhardti</u>	Dec-Ja 71-72 SM Transect, Gua. 1900 M Bromeliad in wet forest
004	16.6	1.8	14.0-18.0	<u>Bolitoglossa franklini</u>	June 70 SM transect 2350 M elev Wet forest bromeliads
003	16.6	2.0	14.4-18.4	<u>Bolitoglossa franklini</u>	Aug-Sept 72 Ibid. 2100 M
001	15.2		<u>Bolitoglossa franklini</u>	Ibid. 2450 M	
004	12.6	0.3	12.3-12.9	<u>Bolitoglossa franklini</u>	Aug 75 Ibid 2125 M
004	10.5	1.0	9.0-11.0	<u>Bolitoglossa franklini</u>	Nov 74 2450 M Ibid
005	17.1	3.1	12.0-19.4	<u>Bolitoglossa franklini</u>	Dec-Ja 71-71 1950 M Ibid
002	13.8	2.0	12.4-15.2	<u>Bolitoglossa franklini</u>	Ibid 2350 M
003	12.8	1.4	12.0-14.4	<u>Bolitoglossa hartwegi</u>	Aug 75 Xantehuitz, Chis. Mex 2750 M Under logs clearing in wet forest
001	20.5		<u>Bolitoglossa mexicana</u>	Aug 72 Jitotol Road, Chis., Mex.	1650 M Under log in open pine woods
002	13.3	3.9	10.5-16.0	<u>Bolitoglossa mario</u>	Jun 70 SM Trans. Gua. 2750 M Under rock, log clearing in wet forest
002	12.0	2.0	10.6-13.4	<u>Bolitoglossa mario</u>	Dec-Ja 70 2850 M Ibid
001	16.5		<u>Bolitoglossa nigroflavescens</u>	Feb 72 Motozintla Rd, Chis.	Mex 2150 M Bromeliad in wet forest
008	22.8	1.0	21.5-24.0	<u>Bolitoglossa occidentalis</u>	Aug 72 SM Trans 1100 M In banana plants
012	22.7	0.8	21.4-24.0	<u>Bolitoglossa occidentalis</u>	Aug 75 Ibid
009	27.4	1.2	24.5-28.4	<u>Bolitoglossa occidentalis</u>	Aug 75 Rd to Nueva Altemani, Chis. Mex. 600 M Banana plants
002	29.9	0.1	29.8-30.0	<u>Bolitoglossa occidentalis</u>	Aug 75 Cruz Blanca, Chis., Mex. 500 M In banana plants
012	20.9	1.1	19.0-22.4	<u>Bolitoglossa occidentalis</u>	Dec-Jan 71-72 SM Trans. Gua. 1100 M In banana plants
013	19.2	0.8	17.8-20.2	<u>Bolitoglossa occidentalis</u>	Feb 74 Ibid

## DATE, LOCALITY, ELEVATION, ETC.

3

N	MEAN SD	RANGE	SPECIES	
002	24.3	24.0-24.6	<u>Bolitoglossa</u> <u>platydactyla</u>	Jul 79 Fortin de Los Flores, Veracruz, Mex 970 M In banana plants ***
005	14.9	1.2	13.2-16.0	<u>Bolitoglossa resplendens</u> Jun 70 SM Trans, Gua. 2450 M Bromeliad, under rock in wet forest
002	09.1	1.6	08.0-10.2	<u>Bolitoglossa resplendens</u> Ibid 2825 M Inside log and under rock
001	13.6		<u>Bolitoglossa resplendens</u>	Aug 72 9 Mi NW San Cristobal, Chis., Mex. 2500 M Under log oak-pine forest
001	13.0		<u>Bolitoglossa resplendens</u>	Aug 72 SM Trans, Gua. 2850 M In stump wet forest
004	11.9	1.0	10.5-12.4	<u>Bolitoglossa resplendens</u> Dec-Jan 71-72 Ibid 2725 M Under log & in bromeliad, moist-wet forest
039	14.6	2.5	07.8-18.2	<u>Bolitoglossa rostrata</u> Jun 70 SM Trans, Gua 2775M Under rocks&logs in meadow edge wet forest
033	14.6	1.2	13.0-17.4	<u>Bolitoglossa rostrata</u> Aug-Sept 72 Ibid
029	13.4	0.8	12.2-15.5	<u>Bolitoglossa rostrata</u> Aug 75 2775 M Ibid
051	10.5	1.8	08.0-14.0	<u>Bolitoglossa rostrata</u> Dec-Jan 71-2 Ibid 2750 M
008	14.6	0.3	13.9-14.8	<u>Bolitoglossa rostrata</u> Jul 70 Cuchumatanes, Gua. 2850 M Under rocks inside logs meadow woods edge
002	14.0	0.6	13.5-14.4	<u>Bolitoglossa rostrata</u> Aug 75 Xantehuitz, Chis., Mex. 2750 M Rock ledge, bark road thru wet forest
036	08.2	2.0	05.5-12.5	<u>Bolitoglossa rostrata</u> Nov 74 Ibid 2775 M
004	25.6	1.4	24.6-27.6	<u>Bolitoglossa rufescens</u> Jul 79 3.3 Km E Penuela, Veracruz, Mex 600 M In banana plants ***
002	21.8	0.3	21.6-22.0	<u>Bolitoglossa rufescens</u> Sept 72 Cuautlapam, Ver. Mex. 1250 M Banana plants in cafetal
001	20.0		<u>Bolitoglossa rufescens</u>	July 76 Ibid 1000 M
009	19.3	1.6	17.0-20.8	<u>Bolitoglossa rufescens</u> Jan 74 Ibid 1250 M
002	14.4	0.0	14.4-14.4	<u>Bolitoglossa subpalmata</u> Sep 61 Cerro Dela Muerte, Cartago Prov, Costa Rica 2760 M
015	12.8		<u>Bolitoglossa subpalmata</u>	Cerro de la Muerte, Costa Rica Nest site Vial (1968)
			<u>Bolitoglossa subpalmata</u>	Cerro de la Muerte, Costa Rica 2926M Vial (1968)
			<u>Bolitoglossa subpalmata</u>	Sep Cerro de la Muerte, Costa Rica 2926M Vial (1968)
			<u>Bolitoglossa subpalmata</u>	May Cerro de la Muerte, Costa Rica 3200 M Vial (1968)
600	02.8-23.8		<u>Bolitoglossa subpalmata</u>	Throughout year Cerro de la Muerte, Costa Rica 1500-3200 M Vial (1968)
188	08.8	0.6	06.4-12.8	<u>Bolitoglossa subpalmata</u> Throughout year Ibid (active) Vial (1968)
001	16.6		<u>Chiropterotriton bromeliacia</u>	June 70 SM Transect, Gua 2400 M Bromeliad in wet forest
016	12.5	0.3	12.2-12.8	<u>Chiropterotriton bromeliacia</u> Ibid 2650 M
002	14.8	1.1	14.0-15.5	<u>Chiropterotriton bromeliacia</u> Aug-Sep 72 Ibid 2450 M
009	13.1	0.5	12.5-14.0	<u>Chiropterotriton bromeliacia</u> Aug 75 2125 M Ibid
006	09.4	0.3	09.0-09.8	<u>Chiropterotriton bromeliacia</u> Nov 74 Ibid 2450 M
015	13.7	1.4	12.4-15.2	<u>Chiropterotriton bromeliacia</u> Dec-Ja 71-2 2350 Ibid
008	10.6	0.0	10.6-10.6	<u>Chiropterotriton bromeliacia</u> Ibid 2600 M

## DATE, LOCALITY, ELEVATION, ETC.

N	MEAN SD	RANGE	SPECIES	
007	10.9	1.1	09.6-12.4	<u>Chiropterotriton chiropterus</u> Jul 76 20 Km W Tres Cumbres, Morelos, Mex. 3130 M Under bark, chips fir forest
001	14.1		<u>Chiropterotriton chiropterus</u> Jul 76 Above Xometla, Ver., Mex. 2610 M Inside log in forest	
006	-10.8	0.4	10.2-11.2	<u>Chiropterotriton chiropterus</u> Jul 76 Puerto Del Aire, Ver., Mex. 2380 M Bromeliads in oak-pine forest
001	12.8		<u>Chiropterotriton chiropterus</u> Jul 76 16 Km N Perote, Ver., Mex. 2220 M Under rock road cut	
005	11.7	1.0	10.5-12.4	<u>Chiropterotriton chiropterus</u> Jul 76 Las Vigas, Ver., Mex. 2420 M Under logs, Oak-pine forest
015	09.7	2.1	07.8-16.2	<u>Chiropterotriton chiropterus</u> Jul 76 Popocatepetl, Mex., Mex. 3300 M Under wood chips fir forest
006	11.5	2.3	08.5-14.2	<u>Chiropterotriton chiropterus</u> Ibid 3230 M Under bark logs in pine fir forest
008	12.0	1.6	10.2-14.0	<u>Chiropterotriton chondrostega</u> Jan 74 Rd to Tlanguistengo, Hidalgo, Mex. 2100 M Under logs/bark pine forest
004	11.9	1.1	11.0-13.5	<u>Chiropterotriton dimidiata</u> Sep 72 El Chico Natl Pk, Hidalgo, Mex. 2850 M Under rocks/logs oak-fir forest
014	09.7	1.4	09.0-12.0	<u>Chiropterotriton dimidiata</u> Jan 74 Ibid 2650 M
011	20.3	0.9	18.6-21.8	<u>Chiropterotriton lavae</u> Jul 79 La Joya, Veracruz, Mex. 2125 M In bromeliads on oak-pine ***
012	12.4	0.9	11.0-13.8	<u>Chiropterotriton multidentata</u> Sept 72 Ibid 2850 M
004	08.7	1.3	08.0-10.6	<u>Chiropterotriton multidentata</u> Jan 74 Ibid 2650 M
006	18.6	1.6	17.6-21.8	<u>Lineatriton lineola</u> Jul 76 Cuautlapam, Ver., Mex. 1100 M In dry stream bank in cafetal
002	18.3	0.1	18.2-18.3	<u>Parvimolge townsendi</u> Jul 76 Ibid 1000 M
001	09.6		<u>Pseudoeurycea altamazonica</u> Jul 76 Zempoala, Morelos, Mex. 3130 M Under log in fir forest	
012	13.6	1.2	11.7-15.6	<u>Pseudoeurycea bellii</u> Jul 76 Nevado de Toluca, Mex., Mex. 3320 M Under rocks @ fir forest border
007	15.5	1.0	14.0-16.8	<u>Pseudoeurycea bellii</u> Jul 76 Sierra de Cuatro Venados, Oaxaca, Mex. 2760 M Under logs in pine woods
008	13.1	0.8	12.2-14.0	<u>Pseudoeurycea brunnata</u> Jun 70 SM Trans, Gua. 2650 M Under logs wet forest
002	13.9	1.6	12.8-15.0	<u>Pseudoeurycea brunnata</u> Ibid 2450 M
006	10.7	0.5	10.5-11.8	<u>Pseudoeurycea brunnata</u> Dec-Jan 71-2 Ibid 2650 M
001	07.8		<u>Pseudoeurycea cephalica</u> Jan 74 El Chico Natl Pk, Hidalgo, Mex. 2650 M Under log moist oak-fir forest	
013	12.9	0.7	11.8-13.7	<u>Pseudoeurycea cephalica</u> Jul 76 N Perote, Veracruz, Mex. 2220 M Under rocks in road cut
001	12.2		<u>Pseudoeurycea cochranae</u> Jul 76 Sierra de Cuatro Venados, Oaxaca, Mex. 2750 M Inside log open pine woods	
002	14.5	0.4	14.2-14.7	<u>Pseudoeurycea cochranae</u> Jul 76 NE Tejocote, Oaxaca, Mex. 2350 M Under litter oak-pine forest
002	10.1	1.0	09.4-10.8	<u>Pseudoeurycea gadovi</u> Jul 76 Xometla, Veracruz, Mex. 2610 M Under bark of stump, forest
07.0			<u>Pseudoeurycea gadovi</u> Mt Orizaba, Veracruz, Mex. Swan (1952)	
010	13.0	0.6	12.4-14.0	<u>Pseudoeurycea goebeli</u> Jun 70 SM Trans, Gua. 2650 M Under logs in wet forest
001	11.2		<u>Pseudoeurycea goebeli</u> Dec-Ja 71-2 Ibid 2350 M	
005	10.1	2.1	08.0-12.4	<u>Pseudoeurycea goebeli</u> Ibid 2700 M

N	MEAN	SD	RANGE	SPECIES	DATE, LOCALITY, ELEVATION, ETC.
021	10.4	0.5	09.2-11.0	<u>Pseudoeurycea</u> <u>leprosa</u>	Jul 76 Zempoala, Morelos, Mex 3130 M Under logs, bark in fir forest
001	11.2			<u>Pseudoeurycea</u> <u>leprosa</u>	Jul 76 Xometla, Veracruz, Mex 2610 M Forest
004	13.8	1.0	12.4-14.5	<u>Pseudoeurycea</u> <u>leprosa</u>	Perote, Veracruz, Mex. 2220 M Under rocks in road cut
006	09.3	0.6	08.3-09.9	<u>Pseudoeurycea</u> <u>leprosa</u>	Popocatepetl, Mex. Mex 3300 M In wood chips fir forest
013	11.9	2.8	07.8-17.4	<u>Pseudoeurycea</u> <u>leprosa</u>	Jul 76 Ibid 3230 M
001	19.0			<u>Pseudoeurycea</u> <u>nigromaculata</u>	Sep 72 Cuautlapam, Veracruz, Mex 1625M In bromeliad wet forest
037	10.3	1.7	07.5-15.8	<u>Pseudoeurycea</u> <u>rex</u>	Aug-Sep 72 SM Trans, Gua 3550 M Under rocks, logs in open pine/grass
002	14.5	0.0	14.5-14.5	<u>Pseudoeurycea</u> <u>rex</u>	Aug 75 Cerro Mozotal, Chiapas, Mex 2850 M Under/in log, meadow in fir forest
015	05.4	1.3	03.0-08.3	<u>Pseudoeurycea</u> <u>rex</u>	Feb 74 SM Trans, Gua. 3475 M Under rocks, logs in open pine/grass
001	09.6			<u>Pseudoeurycea</u> 'rex'-like	Jun 70 Ibid 2850 M In log in wet forest
001	13.0			<u>Pseudoeurycea</u> 'rex'-like	Aug 72 Ibid
006	08.8	1.3	08.0-10.5	<u>Pseudoeurycea</u> 'rex'-like	Dec-Jan 71-2 Ibid 2750 M In bromeliad, under bark @ wet forest
005	12.1	1.0	10.6-13.2	<u>Pseudoeurycea</u> <u>robertsi</u>	Jul 76 Nevado de Toluca, Mex, Mex 3320 M Under rocks fir forest border
054	14.2	2.1	10.2-20.2	<u>Pseudoeurycea</u> <u>smithi</u>	Jul 76 Cerro San Felipe, Oaxaca, Mex 2960 M Under/in logs oak-pine forest
013	13.0	1.5	11.4-16.0	<u>Pseudoeurycea</u> sp.	Nov. Jul 76 Liguá de Vaca, Mex, Mex 2860 M Under bark or chips oak-fir forest
010	15.3	2.9	11.8-22.2	<u>Pseudoeurycea</u> <u>unguentis</u>	Jul 76 Cerro San Felipe, Oaxaca, Mex 2960 M Under bark oak-pine forest
004	11.8	0.7	10.8-12.4	<u>Thorius</u> <u>dubitans</u>	Jul 76 Puerto del Aire, Veracruz, Mex 2380 M Bromeliads in oak-pine forest
019	16.4	3.0	10.4-21.2	<u>Thorius</u> <u>narisovalis</u>	Jul 76 Cerro San Felipe, Oaxaca, Mex 2840 M Under bark/logs in forest clearing
007	13.7	1.8	12.2-16.4	<u>Thorius</u> <u>narisovalis</u>	Jul 76 Ibid 2960 M Under leaves/bark in oak-pine forest
001	23.0			<u>Thorius</u> <u>pennatus</u>	Sep 72 Cuautlapam, Veracruz, Mex 1250 M Under rock in cañada
014	11.9	1.2	10.2-13.8	<u>Thorius</u> <u>macdougalii</u>	Jul 76 Llano de las Flores, Oaxaca, Mex 2830 M Under logs/bark in meadow
015	19.7	1.2	18.0-21.4	<u>Thorius</u> sp. 'pulmonaris'	Jul 76 Sola de Vega, Oaxaca, Mex 2150 M Under rocks/logs in pine-oak forest
033	11.7	1.0	10.1-14.0	<u>Thorius</u> <u>troglodytes</u>	Jul 76 Puerto del Aire, Veracruz, Mex 2380 M Under rocks/logs in oak-pine forest
					B. NON-PLETHODONTIDS (AMBYSTOMATIDS):
16.0				<u>Ambystoma</u> <u>amblycephalum</u>	Nov Irazo, Mich, Mex 2130 M Larvae in stream
26.0				<u>Ambystoma</u> <u>amblycephalum</u>	Aug Ibid
29.0				<u>Ambystoma</u> <u>amblycephalum</u>	Aug 9.8 MI w Morelia, Mich, Mex 1920 M Adults in pond
14.6				<u>Ambystoma</u> <u>dumerilii</u>	Jan Lago Patzcuaro, Mich, Mex 2010 M Larvae in large lake
14.8				<u>Ambystoma</u> <u>dumerilii</u>	Jan Ibid
14.3				<u>Ambystoma</u> <u>dumerilii</u>	Jan Ibid

## DATE, LOCALITY, ELEVATION, ETC.

N	MEAN	SD	RANGE	SPECIES	
21.0				<u>Ambystoma dumerilii</u>	Nov Ibid
25.0				<u>Ambystoma dumerilii</u>	Aug Ibid
23.0				<u>Ambystoma flavipiperatum</u>	Aug Guadelajara, Jal, Mex 1550 M Larvae in pond
18.0				<u>Ambystoma flavipiperatum</u>	Nov Ibid
18.0				<u>Ambystoma granulosum</u>	Nov 11.6 Mi W Toluca, Mex, Mex 2500 M Larvae in pond
18.0				<u>Ambystoma granulosum</u>	Aug 9 Mi W Toluca, Mex, Mex 2450 M Larvae in pond
16.0				<u>Ambystoma granulosum</u>	Jan Ibid Sexually mature and young larvae
28.0				<u>Ambystoma larmaensis</u>	Jun Almolya, Mex, Mex 2400 M Larvae in large pond
20.0				<u>Ambystoma mexicanum</u>	Nov Mixquic, DF, Mex 2200 M Larvae in canal
13.0				<u>Ambystoma ordinarium</u>	Jun W SJ De la Cumbre, Mich, Mex 2360 M Larvae in stream
18.0				<u>Ambystoma ordinarium</u>	Jun W SJ Lagunillas, Mich, Mex 2490 M Larvae in stream
17.0				<u>Ambystoma ordinarium</u>	Dec Ibid
14.0				<u>Ambystoma ordinarium</u>	Jan Ibid
17.0				<u>Ambystoma ordinarium</u>	Aug 10 Mi SE San Gregorio, Mich, Mex 2100 M Larvae in stream
11.8-12.4				<u>Ambystoma ordinarium</u>	Jun 67 Puerto Garnica, Michoacan, Mex 2790 M Anderson and Worthington (1971)
22.0				<u>Ambystoma rosaceum</u>	Jun Colonia Garcia, Chih, Mex 2100 M Larvae in stream
20.5				<u>Ambystoma rosaceum</u>	Jun S Colonia Garcia, Chih, Mex 2100 M Larvae in pond
16.0				<u>Ambystoma rosaceum</u>	Jun Largo, Chih, Mex 2150 M Larvae in pond
30.0				<u>Ambystoma rosaceum</u>	Jun Yepomera, Chih, Mex 1900 M Larvae in stream
16.0				<u>Ambystoma rosaceum</u>	Jun El Vergel, Chih, Mex 2450 M Larvae in stream
20.0				<u>Ambystoma rosaceum</u>	Jun El Salto, Durango, Mex 2600 M Larvae in stream
13.0				<u>Ambystoma rosaceum</u>	Nov La Ciudad, Durango, Mex 2500 Larvae in pond
26.0				<u>Ambystoma subsalsum</u>	Dec Alchichica, Puebla, Mex 2200 M Sex mat larvae in Caldera Lake
15.0				<u>Ambystoma tigrinum</u>	Nov 71 El Chico National Park, Hidalgo, Mexico 2925M Stream in montane meadow
001 10.5	10.5-10.5			<u>Ambystoma tigrinum</u>	Dec Tecuitlapa, Puebla, Mex. 2270 M Mature larvae in Caldera Lake
15.0				<u>Ambystoma tigrinum</u>	Dec Cofre de Perote, Puebla, Mex. 2800 M Larvae in stream
10.5				<u>Ambystoma tigrinum</u>	Aug Ibid Mature larvae
12.5				<u>Ambystoma tigrinum</u>	Aug 68 Mi S Galeana, Chih., Mex. 2160 M Larvae in pond
26.0				<u>Ambystoma tigrinum</u>	Aug 6 Mi NW Yepomera, Chih., Mex. 2000 M Larvae in pond
19.0				<u>Ambystoma tigrinum</u>	Aug 6 Mi NW Yepomera, Chih., Mex. 2000 M Larvae in pond

N	MEAN SD	RANGE	SPECIES	DATE, LOCALITY, ELEVATION, ETC.
			<u>Ambystoma tigrinum</u>	Aug 33 Mi E Tomassachic, Chih., Mex 2100 M Larvae in pond
26.0			<u>Ambystoma tigrinum</u>	Aug 16 Mi E Tomachic, Chih., Mex 2200 M Larvae in pond
24.0			<u>Ambystoma tigrinum</u>	Aug San Martin, Mex, Mex. 1920 M Larvae in ditch
18.0			<u>Ambystoma tigrinum</u>	Aug 42.5 Mi E Valle de Bravo, Mex 2600 M Larvae in pond
22.0			<u>Ambystoma tigrinum</u>	Aug 1.5 Mi N Villa Hidalgo, SLP, Mex 1618M Adults in pond
22.0			<u>Ambystoma tigrinum</u>	Aug Vic SJ Iturbide, Guanajuato, Mex 2023M Adults & larvae in pond
19.0			<u>Ambystoma tigrinum</u>	Jun El Vergel, Chih., Mex 1900 M Sexually mature larvae in pond
19.0			<u>Ambystoma tigrinum</u>	Jun Hidalgo-Mexico border, Mex 2320 M Larvae in pond
17.0			<u>Ambystoma tigrinum</u>	Nov Mimbres, Durango, Mex 2250 M Larvae in pond
19.0			<u>Ambystoma tigrinum</u>	Nov Ibid 2350 M
17.0			<u>Ambystoma tigrinum</u>	Nov Vic El Salto, Durango, Mex 2530 M Larvae in pond
18.0			<u>Ambystoma tigrinum</u>	Nov Tapalpa, Jalisco, Mex 2110 M Adults in stream
19.0			<u>Ambystoma tigrinum</u>	Nov Patzcuaro, Mich., Mex 1970 M Larvae in cattle pond
15.0			<u>Ambystoma tigrinum</u>	Jan Ibid
14.0			<u>Ambystoma tigrinum</u>	Jan Nopaltepec, Mex, Mex 2360 M All stages in pond
18.0			<u>Ambystoma 'zacapu'</u>	Jun Lago de Zacapu, Mich., Mex 1930 M Larvae in large lake
20.5			<u>Ambystoma 'zacapu'</u>	Jun Ibid Stream draining lake
15.0			<u>Ambystoma 'zacapu'</u>	Jan Ibid
17.0			<u>Ambystoma 'zacapu'</u>	Nov Ibid
14.0			<u>Rhyacosiredon altimirani</u>	Jun Chalma, Mex, Mex 2880 M Larvae and adults in stream
11.0			<u>Rhyacosiredon rivularis</u>	Nov 7.7 Mi N Villa Victoria, Mex 2480 M Larvae in stream
				TEMPERATE ZONE SALAMANDERS
				A. PLETHODONTIDS:
			18.0	<u>Aneides aeneus</u> Jun NC 4100' Gordon and Smith (1949)
			11.1-22.2	<u>Aneides aeneus</u> Jun NC Gordon (1952)
			12.2-20.0	<u>Aneides aeneus</u> Jun NC Gordon (1952)
001	20.5			<u>Aneides ferreus</u> Jun OR Brattstrom (1963)
003	17.0	0.2	16.8-17.1	<u>Aneides ferreus</u> Jun OR Brattstrom (1963)
035	12.8	1.8		<u>Aneides flavipunctatus</u> Nov CA Lynch (1974)

## DATE, LOCALITY, ELEVATION, ETC.

## SPECIES

## N MEAN SD RANGE

012	06.1	1.7		<u>Aneides flavipunctatus</u> Jan CA Lynch (1974)
027	14.8	1.5		<u>Aneides flavipunctatus</u> Nov CA Lynch (1974)
010	13.7	1.6		<u>Aneides flavipunctatus</u> Nov CA Lynch (1974)
010	09.2	2.3		<u>Aneides flavipunctatus</u> Jan CA Lynch (1974)
025	12.1	0.8		<u>Aneides flavipunctatus</u> Nov CA Lynch (1974)
010	07.4	0.7		<u>Aneides flavipunctatus</u> Jan CA Lynch (1974)
041	13.1	1.4		<u>Aneides flavipunctatus</u> Nov-Dec CA Lynch (1974)
032	09.2	4.5		<u>Aneides flavipunctatus</u> Jan-Feb CA Lynch (1974)
030	14.0	0.6		<u>Aneides flavipunctatus</u> Mar-Apr CA Lynch (1974)
001	02.2			<u>Aneides flavipunctatus</u> Dec CA Lynch (1974)
001	18.5			<u>Aneides flavipunctatus</u> Jul CA Lynch (1974)
002	14.5	0.0	14.5-14.5	<u>Aneides hardii</u> Aug NM Stebbins (1951)
010	02.8-15.0			<u>Aneides lugubris</u> CA Stebbins (1951)/Brattstrom (1963)
013	14.4	1.4		<u>Aneides lugubris</u> Nov CA Lynch (1974)
001	13.3			<u>Aneides lugubris</u> Aug CA Stebbins (1954)
056	09.9	2.6	05.0-16.0	<u>Aneides lugubris</u> Nov-Mar CA Rosenthal (1957)
037	10.9	02.0-17.0		<u>Aneides lugubris</u> CA Rosenthal (1957)
067	10.2	08.0-19.0		<u>Aneides lugubris</u> CA Rosenthal (1957)
002	03.4	1.8	02.1-04.6	<u>Aneides lugubris</u> Nov CA Rosenthal (1957)
009	12.6	1.5		<u>Batrachoseps attenuatus</u> Nov CA Lynch (1974)
005	15.8	1.1		<u>Batrachoseps attenuatus</u> Nov CA Lynch (1974)
008	12.1	0.6		<u>Batrachoseps attenuatus</u> Nov CA Feder (Unpublished)
021	02.3	02.2-04.0		<u>Batrachoseps attenuatus</u> Jan CA 500' Hendrickson (1954)
001	13.3			<u>Batrachoseps attenuatus</u> Aug CA Stebbins (1954)
014	10.2-10.5			<u>Batrachoseps attenuatus</u> Feb CA Feder (Unpublished)
026	08.8	1.1	06.8-09.5	<u>Batrachoseps nigriventris</u> Feb CA Feder (Unpublished)
002	19.6	0.1	19.5-19.6	<u>Batrachoseps pacificus</u> Sept CA Brattstrom (1963)
051	12.6	4.3	07.0-17.6	<u>Batrachoseps pacificus</u> Feb CA Feder (Unpublished)
400		04.0-21.0		<u>Batrachoseps pacificus</u> Throughout year CA Cunningham (1960)
003	08.0	0.0	08.0-08.0	<u>Batrachoseps wrighti</u> Apr OR Stebbins (1951)

N	MEAN	SD	RANGE	SPECIES		DATE, LOCALITY, ELEVATION, ETC.
020	08.0	1.9	06.0-14.0	<u>Desmognathus fuscus</u>	Apr NY Feder	(Unpublished)
016	01.0-22.0			<u>Desmognathus fuscus</u>	Apr-Nov OH Ashton	(1975)
001	04.0			<u>Desmognathus fuscus</u>	Dec OH Ashton	(1975)
003	01.0-04.5			<u>Desmognathus fuscus</u>	Winter OH Ashton	(1975)
012	02.5-04.5			<u>Desmognathus fuscus</u>	Winter OH Ashton	(1975)
003	02.0-04.0			<u>Desmognathus fuscus</u>	Winter OH Ashton	(1975)
006	01.0-04.5			<u>Desmognathus fuscus</u>	Winter OH Ashton	(1975)
003	02.5-06.0			<u>Desmognathus fuscus</u>	Winter OH Ashton	(1975)
	06.0-07.0			<u>Desmognathus fuscus</u>	Feb OH Ashton	(1975)
016	05.0	0.0	05.0-05.0	<u>Desmognathus fuscus</u>	Dec OH Ashton	(1975)
003	04.0	0.0	04.0-04.0	<u>Desmognathus fuscus</u>	Dec OH Ashton	(1975)
002	03.5	0.0	03.5-03.5	<u>Desmognathus fuscus</u>	Dec OH Ashton	(1975)
002	12.7	0.7	12.2-13.2	<u>Desmognathus monticola</u>	Brattstrom	(1963)
09.0				<u>Desmognathus monticola</u>	Brattstrom	(1963)
11.0	10.0-12.0			<u>monticola</u>	Mar SC Shealy	(1975)
14.0	14.0-16.0			<u>monticola</u>	Apr SC Shealy	(1975)
14.0	13.0-16.0			<u>monticola</u>	May SC Shealy	(1975)
17.0	17.0-19.0			<u>monticola</u>	Jun SC Shealy	(1975)
19.0	19.0-20.0			<u>monticola</u>	Jul SC Shealy	(1975)
18.0	18.0-20.0			<u>monticola</u>	Aug SC Shealy	(1975)
15.0	14.0-16.0			<u>monticola</u>	Sep SC Shealy	(1975)
13.0	12.0-14.0			<u>monticola</u>	Oct SC Shealy	(1975)
12.0	12.0-13.0			<u>monticola</u>	Dec SC Shealy	(1975)
06.0	05.0-07.0			<u>monticola</u>	Feb SC Shealy	(1975)
03.0	02.0-06.0			<u>monticola</u>	Mar SC Shealy	(1975)
031	17.8	1.2	16.2-20.1	<u>Desmognathus ochrophaeus</u>	Jul VA Bogert	(1952)
031	15.5	1.0	13.2-17.3	<u>Desmognathus ochrophaeus</u>	Jul VA Bogert	(1952)
	01.0-19.0			<u>ochrophaeus</u>	Throughout year Ohio Fitzpatrick	(1973b)
11.0	10.0-12.0			<u>ochrophaeus</u>	Mar SC Shealy	(1975)
14.0	14.0-16.0			<u>ochrophaeus</u>	Apr SC Shealy	(1975)

N	MEAN	SD	RANGE	SPECIES	DATE, LOCALITY, ELEVATION, ETC.
14.0	13.0-16.0			<u>Desmognathus ochrophaeus</u>	May SC Shealy ( 1975 )
17.0	17.0-19.0			<u>Desmognathus ochrophaeus</u>	Jun SC Shealy ( 1975 )
19.0	19.0-20.0			<u>Desmognathus ochrophaeus</u>	Jul SC Shealy ( 1975 )
18.0	18.0-20.0			<u>Desmognathus ochrophaeus</u>	Aug SC Shealy ( 1975 )
15.0	14.0-16.0			<u>Desmognathus ochrophaeus</u>	Sep SC Shealy ( 1975 )
13.0	12.0-14.0			<u>Desmognathus ochrophaeus</u>	Oct SC Shealy ( 1975 )
04.0	03.0-06.0			<u>Desmognathus ochrophaeus</u>	Nov SC Shealy ( 1975 )
12.0	12.0-13.0			<u>Desmognathus ochrophaeus</u>	Dec SC Shealy ( 1975 )
06.0	05.0-07.0			<u>Desmognathus ochrophaeus</u>	Feb SC Shealy ( 1975 )
03.0	02.0-06.0			<u>Desmognathus ochrophaeus</u>	Mar SC Shealy ( 1975 )
004	18.5	17.0-19.8		<u>Desmognathus wrighti</u>	Jul VA Bogert ( 1952 )
003	15.7	15.5-15.8		<u>Desmognathus wrighti</u>	Jul VA Bogert ( 1952 )
14.6	12.4-19.5			<u>Ensatina escholtzii</u>	CA Brattstrom ( 1963 )
002	12.3	0.4	12.0-12.6	<u>Ensatina escholtzii</u>	OR? Brattstrom ( 1963 )
006	12.0	0.7		<u>Ensatina escholtzii</u>	Nov CA Lynch ( 1974 )
002	13.8	0.2	13.6-13.9	<u>Ensatina escholtzii</u>	Nov CA Hendrickson ( 1949 )
002	09.3	0.4	09.0-09.5	<u>Ensatina escholtzii</u>	CA Brattstrom ( 1963 )
001	20.0			<u>Ensatina escholtzii</u>	CA Stebbins ( 1954 )
001	01.0			<u>Ensatina escholtzii</u>	Feb CA Stebbins ( 1954 )
001	01.0			<u>Ensatina escholtzii</u>	Jan CA 1670 M Stebbins ( 1954 )
002	16.0	0.0	16.0-16.0	<u>Ensatina escholtzii</u>	Oct CA Stebbins ( 1954 )
002	12.8	0.7	12.3-13.3	<u>Ensatina escholtzii</u>	Aug CA Stebbins ( 1954 )
108	10.8	0.1	0.0-20.0	<u>Ensatina escholtzii</u>	CA Stebbins ( 1954 )
011	09.3	0.2	5-17.5	<u>Ensatina escholtzii</u>	Oct-Apr CA Stebbins ( 1954 )
046	08.8	0.2	5-17.0	<u>Ensatina escholtzii</u>	CA Stebbins ( 1954 )
004	13.8	11.5-15.7		<u>Ensatina escholtzii</u>	Mar Baja Norte, Mexico Mahrt ( 1975 )
	08.0-16.0			<u>Eurycea b. bislineata</u>	Brattstrom ( 1963 )
039	08.4	3.0	04.5-14.4	<u>Eurycea bislineata</u>	Apr NY Feder ( Unpublished )
002	03.0	0.0	03.0-03.0	<u>Eurycea b. bislineata</u>	Feb Vernberg ( 1953 )
001	08.0			<u>Eurycea b. bislineata</u>	Feb Vernberg ( 1953 )

## DATE, LOCALITY, ELEVATION, ETC.

N	MEAN	SD	RANGE	SPECIES	
			02.0-20.0	<u>Eurycea bislineata</u>	Throughout year Fitzpatrick ( 1973a )
001	01.0-04.5		<u>Eurycea bislineata</u>	Winter OH Ashton ( 1975 )	
003	02.5-04.5		<u>Eurycea bislineata</u>	Winter OH Ashton ( 1975 )	
003	02.0-04.0		<u>Eurycea bislineata</u>	Winter OH Ashton ( 1975 )	
	02.5-06.0		<u>Eurycea bislineata</u>	Winter OH Ashton ( 1975 )	
001	05.0		<u>Eurycea bislineata</u>	Dec OH Ashton ( 1975 )	
002	03.0	0.0	03.5-03.5	<u>Eurycea bislineata</u>	Dec OH Ashton ( 1975 )
001	18.2		<u>Eurycea b. wilderae</u>	Jul VA Bogert ( 1952 )	
004	15.9		15.5-16.6	<u>Eurycea b. wilderae</u>	Jul VA Bogert ( 1952 )
003	17.5		15.0-22.0	<u>Eurycea longicauda</u>	Ark Spotila ( 1972 )
	08.0-19.0		<u>Eurycea longicauda</u>	VA Hutchison ( 1958 )	
011	15.6		13.5-22.2	<u>Eurycea lucifuga</u>	Ark Spotila ( 1972 )
	08.0-19.0		<u>Eurycea lucifuga</u>	VA Hutchison ( 1958 )	
	14.8-16.0		<u>Eurycea multiplicata</u>	<u>griseogaster</u>	Throughout year Arkansas Ireland ( 1976 )
	14.0-18.9		<u>Eurycea multiplicata</u>	<u>griseogaster</u>	Throughout year Arkansas Ireland ( 1976 )
	00.0-21.0		<u>Eurycea multiplicata</u>	<u>griseogaster</u>	Throughout year Arkansas Ireland ( 1976 )
002	26.3	0.1	26.2-26.3	<u>Eurycea [Manculus] quadridigitatus</u>	Texas Brattstrom ( 1963 )
	12.0			<u>Gyrinophilus palleucus</u>	Dent and Kirby-Smith ( 1963 )
017	08.1	2.8	05.0-16.0	<u>Gyrinophilus porphyriticus</u>	Apr NY Feder (Unpublished)
013	11.4	1.3	10.0-14.0	<u>Hydromantes brunus</u>	Mar 73 Hell Hollow, Mariposa co, CA Under rocks on hillside ***
024	05.7		-2.0-11.5	<u>Hydromantes platycephalus</u>	CA Brattstrom ( 1963 )
001	07.1			<u>Hydromantes platycephalus</u>	CA 10800' Bogert ( 1952 )
008	15.0	1.4	13.8-17.8	<u>Hydromantes platycephalus</u>	Jul 81 NE Face sierra buttes, Sierra Co, CA 2125 M Under rocks ***
001	16.0			<u>Hydromantes platycephalus</u>	Jul 81 Ibid 2200 M ***
12.2				<u>Hydromantes shastae</u>	Jun CA Brattstrom ( 1963 )
001	12.2			<u>Hydromantes shastae</u>	Mar CA Bury et al. ( 1969 )
039	16.2		11.6-22.8	<u>Plethodon caddoensis</u>	Arkansas Spotila ( 1972 )
	09.5-17.5		<u>Plethodon cinereus</u>	May-Jun Mich Test and Bingham ( 1948 )	
	07.0-20.0		<u>Plethodon cinereus</u>	May-Jun Mich Test and Bingham ( 1948 )	
134	18.5	0.6	16.8-20.0	<u>Plethodon cinereus</u>	Jul VA Bogert ( 1952 )

## DATE, LOCALITY, ELEVATION, ETC.

N	MEAN	SD	RANGE	SPECIES				
065	17.9	0.9	14.8-19.6	<u>Plethodon cinereus</u>	Ju1	VA	Bogert	(1952)
027	09.9	2.9	06.5-16.0	<u>Plethodon cinereus</u>	Apr	NY	Feder	(Unpublished)
008	15.7	0.3	15.3-16.0	<u>Plethodon cinereus</u>	Aug	NY	Feder	(Unpublished)
114	18.3	2.1	14.1-22.0	<u>Plethodon cinereus</u>	Jun-Jul	NY	Feder	(Unpublished)
003	04.0	0.0	04.0-04.0	<u>Plethodon cinereus</u>	Feb	Vernberg	(1953)	
002	03.0	0.0	03.0-03.0	<u>Plethodon cinereus</u>	Feb	Vernberg	(1953)	
003	03.0	0.0	03.0-03.0	<u>Plethodon cinereus</u>	Feb	Vernberg	(1953)	
007	08.0	0.0	08.0-08.0	<u>Plethodon cinereus</u>	Feb	Vernberg	(1953)	
004	07.0	0.0	07.0-07.0	<u>Plethodon cinereus</u>	Feb	Vernberg	(1953)	
001	05.0			<u>Plethodon cinereus</u>	Feb	Vernberg	(1953)	
002	04.0	0.0	04.0-04.0	<u>Plethodon cinereus</u>	Feb	Vernberg	(1953)	
135	13.3	9.7		<u>Plethodon cinereus</u>	Throughout	Year	Taub	(1961)
003	15.6		15.3-15.8	<u>Plethodon cinereus</u>	serratus	Ark	Spotila	(1972)
008	12.0		11.4-13.0	<u>Plethodon dorsalis</u>	Ark	Spotila	(1972)	
002	11.1	2.7	09.2-13.0	<u>Plethodon dunnii</u>	Brattstrom	(1963)		
017	10.8			<u>Plethodon dunnii</u>	OR	Stebbins	(1951)	
002	15.1		14.4-15.8	<u>Plethodon glutinosus</u>	Ark	Spotila	(1972)	
033	15.2		12.2-19.5	<u>Plethodon glutinosus</u>	Ark	Spotila	(1972)	
001	14.0			<u>Plethodon glutinosus</u>	Brattstrom	(1963)		
039	18.3	0.6	16.8-19.5	<u>Plethodon glutinosus</u>	Ju1	VA	Bogert	(1952)
038	17.8	0.8	16.4-19.5	<u>Plethodon glutinosus</u>	Ju1	VA	Bogert	(1952)
013	18.4	0.6	17.0-19.2	<u>Plethodon huldae</u>	Ju1	VA	Bogert	(1952)
015	18.3	1.0	16.4-20.5	<u>Plethodon metcalifi</u>	Ju1	VA	Bogert	(1952)
021	15.7	0.9	13.5-17.4	<u>Plethodon metcalifi</u>	Ju1	VA	Bogert	(1952)
001	12.8			<u>Plethodon neomexicanus</u>	Aug	NM	Stebbins	(1951)
009	11.0-13.0			<u>Plethodon neomexicanus</u>	Jun	NM	Reagan	(1972)
101	10.5-13.0			<u>Plethodon neomexicanus</u>	Summer	NM	Reagan	(1972)
041	17.0		15.2-21.4	<u>Plethodon ouachitae</u>	Arkansas	Spotila	(1972)	
010	16.1		15.2-17.1	<u>Plethodon welleri</u>	Ju1	VA	Bogert	(1952)
028	06.0			<u>Plethodon vandykei</u>	Apr	WA	Stebbins	(1951)

## DATE, LOCALITY, ELEVATION, ETC.

## SPECIES

## N MEAN SD RANGE

004 10.5 1.4 09.2-12.5 Plethodon vehiculum Brattstrom ( 1963 )001 22.0 Typhlonolge rathbuni Texas -45 M Brattstrom ( 1963 )

## B. NON-PLETHODONTIDS:

048 17.8 07.0-23.7 Ambystoma cingulatum Nov-Dec SC-GA Anderson and Williamson ( 1976 )028 18.1 15.5-19.0 Ambystoma cingulatum Nov SC-GA Night Anderson and Williamson ( 1976 )014 20.1 19.5-23.7 Ambystoma cingulatum Nov SC-GA Day Anderson and Williamson ( 1976 )004 21.4 0.8 20.3-22.3 Ambystoma jeffersonianum Aug Minn. Brattstrom ( 1963 )001 19.0 Ambystoma jeffersonianum Jul Minn. Brattstrom ( 1963 )<01.0 Ambystoma jeffersonianum Mar NY Feder ( Unpubl. )06.0-07.9 Ambystoma jeffersonianum Mar-Apr NJ Panek ( 1978 )054 12.9 5.5 Ambystoma platineum Mar-Apr NJ Panek ( 1978 )06.0-07.8 Ambystoma platineum Mar-Apr NJ Panek ( 1978 )005 21.0 Ambystoma macrodactylum CA 1850 M Brode ( 1967 )223 14.2 06.0-22.0 Ambystoma macrodactylum croceum Throughout yr CA Terrestrial Anderson ( 1968 )006 09.8 09.0-10.4 Ambystoma macrodactylum croceum Throughout yr CA In pond Anderson ( 1968 )15.2 07.0-22.0 Ambystoma macrodactylum croceum Throughout yr CA Under cover Anderson ( 1968 )068 11.4 06.0-16.0 Ambystoma macrodactylum croceum Throughout yr CA Migrating Anderson ( 1968 )012 15.2 Ambystoma macrodactylum croceum Jan CA Anderson ( 1968 )019 08.9 Ambystoma macrodactylum croceum Jan CA Anderson ( 1968 )12.2 10.5-23.2 Ambystoma macrodactylum croceum CA Larvae Anderson ( 1968 )150 15.1 07.0-25.0 Ambystoma macrodactylum croceum CA Larvae Anderson ( 1968 )014 11.5 06.2-16.0 Ambystoma macrodactylum croceum Jan CA Adult terrestrial Anderson ( 1968 )012 11.7 09.0-13.2 Ambystoma macrodactylum croceum Feb CA Adult terrestrial Anderson ( 1968 )016 12.3 11.5-13.5 Ambystoma macrodactylum croceum Mar CA Adult terrestrial Anderson ( 1968 )010 11.5 10.0-12.5 Ambystoma macrodactylum croceum Apr CA Adult terrestrial Anderson ( 1968 )013 18.4 15.4-22.4 Ambystoma macrodactylum croceum Jun CA Adult terrestrial Anderson ( 1968 )010 17.7 16.0-19.4 Ambystoma macrodactylum croceum Aug CA Adult terrestrial Anderson ( 1968 )017 19.1 15.2-20.2 Ambystoma macrodactylum croceum Sep CA Adult terrestrial Anderson ( 1968 )015 16.3 14.4-18.0 Ambystoma macrodactylum croceum Sep CA Adult terrestrial Anderson ( 1968 )011 11.3 09.0-12.8 Ambystoma macrodactylum croceum Nov CA Adult terrestrial Anderson ( 1968 )

N	MEAN	SD	RANGE	SPECIES	DATE, LOCALITY, ELEVATION, ETC.
019	12.9		09.0-14.8	<u>Ambystoma macrodactylum croceum</u>	Nov CA Adult terrestrial Anderson ( 1968 )
027	08.6		04.0-16.0	<u>Ambystoma macrodactylum</u>	<u>sigillatum</u> Jun-Jui CA Adults Anderson ( 1968 )
010			03.4-04.0	<u>Ambystoma macrodactylum</u>	<u>sigillatum</u> Jul CA Adults Anderson ( 1968 )
			03.4-11.0	<u>Ambystoma macrodactylum</u>	<u>sigillatum</u> CA Eggs Anderson ( 1968 )
055	07.4		04.0-14.2	<u>Ambystoma macrodactylum</u>	<u>sigillatum</u> Spring CA Larvae Anderson ( 1968 )
010	23.1		22.0-24.5	<u>Ambystoma macrodactylum</u>	<u>sigillatum</u> Jul-Aug CA Larvae Anderson ( 1968 )
			09.0-21.0	<u>Ambystoma macrodactylum</u>	<u>sigillatum</u> Summer CA Larvae Anderson ( 1968 )
002	08.3	0.1	08.2-08.3	<u>Ambystoma maculatum</u>	Apr NY Brattstrom ( 1963 )
	<01.0			<u>Ambystoma maculatum</u>	Mar NY Feder ( Unpubl. )
			08.0-23.0	<u>Ambystoma maculatum</u>	( eggs ) NY Pough ( 1976 )
			17.0-32.0	<u>Ambystoma maculatum</u>	Jul NY Pough and Wilson ( 1970 )
002	23.9	0.1	23.8-24.0	<u>Ambystoma opacum</u>	Alabama Brattstrom ( 1963 )
001	16.0			<u>Ambystoma opacum</u>	May NY Brattstrom ( 1963 )
			07.0-09.0	<u>Ambystoma opacum</u>	Mar NJ Anderson and Graham ( 1967 )
			04.0-09.0	<u>Ambystoma talpoideum</u>	Jan LA Hardy and Raymond ( 1980 )
			07.0-08.0	<u>Ambystoma talpoideum</u>	Feb LA Hardy and Raymond ( 1980 )
			11.0-16.0	<u>Ambystoma talpoideum</u>	Dec LA Hardy and Raymond ( 1980 )
			05.0-10.0	<u>Ambystoma talpoideum</u>	Jan LA Hardy and Raymond ( 1980 )
			16.0-19.0	<u>Ambystoma talpoideum</u>	Feb-Mar LA Hardy and Raymond ( 1980 )
001			02.5-04.5	<u>Ambystoma texanum</u>	Winter OH Ashton ( 1975 )
007	22.6	1.8	21.2-26.5	<u>Ambystoma tigrinum</u> ( larvae )	Aug CO Brattstrom ( 1963 )
			005	<u>Ambystoma tigrinum</u>	Aug Minn Brattstrom ( 1963 )
			002	<u>Ambystoma tigrinum</u>	Aug Minn Brattstrom ( 1963 )
			011	<u>Ambystoma tigrinum</u>	Aug Minn Brattstrom ( 1963 )
			001	<u>Ambystoma tigrinum</u>	Aug Minn Brattstrom ( 1963 )
			005	<u>Ambystoma tigrinum</u>	Colo ( 8300' ) Stebbins ( 1951 )
			051	<u>Ambystoma tigrinum</u>	Mccclure ( 1943 )
			13.0-25.0	<u>Ambystoma tigrinum</u>	Aug CO Heath ( 1975 )
			06.5-08.1	<u>Ambystoma tigrinum</u>	Jan NM Whitford and Massey ( 1970 )
			06.2-12.8	<u>Ambystoma tigrinum</u>	Mar NM Whitford and Massey ( 1970 )

	12.0-17.5	Ambystoma tigrinum	Apr NM	Whitford and Massey (1970)
	15.0-24.0	Ambystoma tigrinum	Jun NM	Whitford and Massey (1975)
	16.8-17.4	Ambystoma tigrinum	Feb OK	Black (1969)
003	24.0	Amphiuma means	Sept Florida	Brattstrom (1963)
	09.8-22.5	Cryptobranchus alleganiensis	Throughout year	MO Nickerson and Mays (1973)
	26.7-28.0	Cryptobranchus alleganiensis	Aug-Sep PA	Hillis and Bellis (1971)
007	13.6	1.8	12.0-16.2	Dicamptodon ensatus (larvae) Jun-Jul OR Brattstrom (1963)
004	12.1	1.8	10.0-13.7	Dicamptodon ensatus Jun OR Brattstrom (1963)
001	10.0		Dicamptodon ensatus Jun OR Brattstrom (1963)	
001	11.2		Dicamptodon ensatus Jun OR Brattstrom (1963)	
001	13.5		Dicamptodon ensatus Sep ID Nussbaum (1969b)	
10.3			Dicamptodon ensatus May OR Nussbaum (1969b)	
09.2			Dicamptodon ensatus May OR Nussbaum (1969b)	
002	27.3	26.7-27.8	Notophthalmus viridescens	Texas Brattstrom (1963)
009	09.5	07.8-13.5	Notophthalmus viridescens	NY Brattstrom (1963)
	15.2-28.4	Notophthalmus viridescens	July Vermont	Pough (1973)
004	24.0	24.0-24.0	Pseudobranchus striatus	Sept Florida Brattstrom (1963)
	08.0-26.0	Pseudobranchus striatus	Throughout year	Fla Uitsch (1973)
002	09.3	0.1	09.2-09.3	Rhyacotriton olympicus Apr CA Stebbins (1951)
002	08.5	0.1	08.4-08.5	Rhyacotriton olympicus Mar CA Stebbins (1951)
002	09.5	0.1	09.4-09.6	Rhyacotriton olympicus Apr CA Stebbins (1951)
003	07.6	0.1	07.5-07.6	Rhyacotriton olympicus Nov CA Stebbins (1951)
002	08.9	0.1	08.8-08.9	Rhyacotriton olympicus Mar CA Stebbins (1951)
004	07.4	0.1	07.3-07.6	Rhyacotriton olympicus Nov CA Stebbins (1951)
004	07.9	0.1	07.8-08.0	Rhyacotriton olympicus Apr OR Stebbins (1951)
001	06.8		Rhyacotriton olympicus Apr WA Stebbins (1951)	
004	05.9	0.1	05.8-06.0	Rhyacotriton olympicus Apr WA Stebbins (1951)
001	07.6		Rhyacotriton olympicus Apr WA Stebbins (1951)	
08.3			Rhyacotriton olympicus Dec OR Nussbaum (1969a)	
006	14.8	12.5-18.4	Taricha granulosa	Brattstrom (1963)

N	MEAN	SD	RANGE	SPECIES	DATE, LOCALITY, ELEVATION, ETC.
040	11.0			<u>Taricha granulosa</u>	Oct OR Coates et al. (1970)
040	04.5			<u>Taricha granulosa</u>	Nov OR Coates et al. (1970)
	09.0-26.0			<u>Taricha rivularis</u>	CA Licht and Brown (1967)
	22.0-23.8			<u>Taricha torosa</u>	Jun CA Brattstrom and Warren (1953)
001	13.3			<u>Taricha torosa</u>	Aug CA Stebbins (1954)
008	17.2	1.0	15.8-18.3	<u>Taricha torosa</u>	Jun CA Stebbins (1951)
034	14.5	0.6	13.3-16.0	<u>Salamandra salamandra</u>	Aug Oviedo Prov., Spain Busack (1978)
	08.0-26.0			<u>Siren intermedia</u>	Throughout year Fla Ultsch (1973)
	08.0-26.0			<u>Siren lacertina</u>	Throughout year Fla Ultsch (1973)

Table 2: Annual variation in the body temperatures of salamanders. Because body temperature varies with elevation, we limited annual records to those tropical species for which summer and winter series were available at the same or similar elevations.

Minimum	Maximum	Range	Species	Minimum reference	Maximum reference
<b>Tropical plethodontids:</b>					
12.0	19.4	07.4	<i>Bolitoglossa franklini</i> (ca. 2000 M)	Lynch (1974)	Same as minimum
09.0	18.0	09.0	<i>Bolitoglossa franklini</i> (ca. 2350 M)	Rosenthal (1957)	Same as minimum
17.8	24.0	06.2	<i>Bolitoglossa occidentalis</i>	Hendrickson (1954)	Same as minimum
10.5	16.0	05.5	<i>Bolitoglossa respaldens</i>	Cunningham (1960)	Same as minimum
07.8	18.2	10.4	<i>Bolitoglossa rostrata</i> (SM Transect)	Ashton (1975)	Same as minimum
05.5	14.4	08.9	<i>Bolitoglossa rostrata</i> (Xantehuitz)	Shealy (1975)	Same as minimum
10.6	15.5	04.9	<i>Chiropterotriton bromeliacea</i>	Fitzpatrick (1973b)	Same as minimum
09.0	13.5	04.5	<i>Chiropterotriton dimidiata</i>	Stebbins (1954)	Same as minimum
08.0	13.8	05.8	<i>Chiropterotriton multidentatus</i>	Ashton (1975)	Fitzpatrick (1973a)
03.0	15.8	12.8	<i>Pseudoeurycea rex</i>	Hutchison (1958)	Spotila (1972)
08.0	13.0	05.0	<i>Pseudoeurycea rex</i> 'rex-like'	Desmognathus monticola	Spotila (1972)
<b>Tropical non-plethodontids:</b>					
16.0	29.0	13.0	<i>Ambystoma amblycephalum</i> (1920-2130 M)	Ireland (1976)	Same as minimum
14.3	25.0	10.7	<i>Ambystoma dumetelli</i>	Ireland (1976)	Same as minimum
18.0	23.0	05.0	<i>Ambystoma flavipiperatum</i>	Hillis and Bellis (1971)	Brattstrom (1963)
16.0	18.0	02.0	<i>Ambystoma granulosum</i>	Nickerson and Mays (1973)	Same as minimum
13.0	18.0	05.0	<i>Ambystoma ordinarium</i> (2360-2490 M)	Nussbaum (1969b)	Anderson (1968)
15.0	26.0	11.0	<i>Ambystoma tigrinum</i> (1970-2100 M)	Brattstrom (1963)	Same as minimum
14.0	26.0	12.0	<i>Ambystoma tigrinum</i> (2250-2360 M)	Ultsch (1973)	Pough (1973)
13.0	20.0	07.0	<i>Ambystoma rosaceum</i> (2450-2600 M)	Ireland (1976)	Same as minimum
15.0	20.5	05.5	<i>Ambystoma zacapu'</i>	Brattstrom (1963)	Same as minimum
<b>Temperate plethodontids:</b>					
02.2	18.5	16.3	<i>Aneides flavipunctatus</i>	Vernberg (1953)	Feder (Unpublished)
02.1	19.0	16.9	<i>Aneides lugubris</i>	Brattstrom (1963)	Brattstrom (1963)
02.2	15.8	13.6	<i>Batrachoseps attenuatus</i>	Whitford and Massey (1970)	Same as minimum
04.0	21.0	17.0	<i>Batrachoseps pacificus</i>	Nickerson and Mays (1973)	Anderson (1968)
01.0	22.0	21.0	<i>Desmognathus fuscus</i>	Brattstrom (1963)	Pough (1973)
02.0	20.0	18.0	<i>Desmognathus monticola</i>	Ultsch (1973)	Same as minimum
01.0	19.0	18.0	<i>Desmognathus ochrophaeus</i>	Stebbins (1951)	Same as minimum
01.0	20.0	19.0	<i>Eurycea escholtzii</i>	Ashton (1975)	Fitzpatrick (1973a)
01.0	20.0	19.0	<i>Eurycea bislineata</i>	Hutchison (1958)	Spotila (1972)
08.0	22.0	14.0	<i>Eurycea longicauda</i>	Hutchison (1958)	Spotila (1972)
08.0	22.2	14.2	<i>Eurycea lucifuga</i>	Ireland (1976)	Same as minimum
00.0	21.0	21.0	<i>Eurycea multiplicata griseogaster</i>	Ireland (1976)	Same as minimum
14.9	16.0	01.2	<i>Eurycea multiplicata griseogaster</i>	Brattstrom (1963)	Same as minimum
-2.0	11.5	13.5	<i>Hydromantes platycephalus</i>	Brattstrom (1963)	Same as minimum
03.0	22.0	19.0	<i>Plethodon cinereus</i>	Vernberg (1953)	Feder (Unpublished)
<b>Temperate non-plethodontids:</b>					
01.0	22.3	21.3	<i>Ambystoma jeffersonianum</i>	Feder (Unpublished)	Brattstrom (1963)
06.2	25.0	18.8	<i>Ambystoma macrodactylum croceum</i>	Anderson (1968)	Same as minimum
03.4	24.5	21.1	<i>Ambystoma macrodactylum signillatum</i>	Feder (Unpublished)	Same as minimum
01.0	32.0	31.0	<i>Ambystoma maculatum</i>	Whitford and Massey (1970)	Pough and Wilson (1970)
06.2	24.0	17.8	<i>Ambystoma tigrinum</i>	Nickerson and Mays (1973)	Hillis and Bellis (1971)
09.8	28.0	18.2	<i>Cryptobranchus alleganiensis</i>	Nussbaum (1969b)	Brattstrom (1963)
09.2	16.2	07.0	<i>Dicamptodon ensatus</i>	Brattstrom (1963)	Same as minimum
07.8	28.4	20.6	<i>Notophthalmus viridescens</i>	Ultsch (1973)	Same as minimum
08.0	26.0	18.0	<i>Pseudobranchus striatus</i>	Ultsch (1973)	Same as minimum
05.8	09.6	03.8	<i>Rhyacotriton olympicus</i>	Stebbins (1951)	Same as minimum
04.5	18.4	13.9	<i>Taricha granulosa</i>	Coates et al. (1970)	Brattstrom (1963)
08.0	26.0	18.0	<i>Siren intermedia</i>	Ultsch (1973)	Same as minimum
08.0	26.0	18.0	<i>Siren lacertina</i>	Ultsch (1973)	Same as minimum

Table 3: Minimum and maximum records for salamander species. '0' refers to record for summer; '1' refers to record for winter.

Minimum	Season	Maximum	Season	Species
<b>Tropical plethodontids:</b>				
11.8	0	11.8	0	<u>Bolitoglossa compacta</u>
20.0	0	22.4	0	<u>Bolitoglossa dunnii</u>
11.6	1	19.4	1	<u>Bolitoglossa engelhardti</u>
09.0	1	19.4	1	<u>Bolitoglossa franklini</u>
12.0	0	14.4	0	<u>Bolitoglossa hartwegi</u>
20.5	0	20.5	0	<u>Bolitoglossa mexicanum</u>
10.5	0	16.0	0	<u>Bolitoglossa morio</u>
16.5	1	16.5	1	<u>Bolitoglossa nigroflavescens</u>
17.8	1	30.0	0	<u>Bolitoglossa occidentalis</u>
08.0	0	16.0	0	<u>Bolitoglossa resplendens</u>
05.5	1	18.2	0	<u>Bolitoglossa rostrata</u>
17.0	1	22.0	0	<u>Bolitoglossa rufescens</u>
02.8	1	23.8	0	<u>Bolitoglossa subpalmata</u>
09.0	1	16.6	0	<u>Chiropterotriton bromeliacea</u>
07.8	0	16.2	0	<u>Chiropterotriton chiropterus</u>
10.2	1	14.0	1	<u>Chiropterotriton chondrostega</u>
09.0	1	13.5	0	<u>Chiropterotriton dimidiata</u>
08.0	1	13.8	0	<u>Chiropterotriton multidentata</u>
17.6	0	21.8	0	<u>Lineatriton lineola</u>
18.2	0	18.3	0	<u>Parvimolge townsendi</u>
09.6	0	09.6	0	<u>Pseudoeurycea altamontana</u>
11.7	0	16.9	0	<u>Pseudoeurycea bellii</u>
10.5	1	15.0	0	<u>Pseudoeurycea brunnata</u>
12.2	0	14.7	0	<u>Pseudoeurycea cochranae</u>
06.0	0	10.8	0	<u>Pseudoeurycea gadovii</u>
08.0	1	14.0	0	<u>Pseudoeurycea goebeli</u>
07.8	0	17.4	0	<u>Pseudoeurycea leprosa</u>
19.0	0	19.0	0	<u>Pseudoeurycea nigromaculata</u>
03.0	1	15.8	0	<u>Pseudoeurycea rex</u>
08.0	1	13.0	0	<u>Pseudoeurycea 'rex-like'</u>
10.6	0	16.0	0	<u>Pseudoeurycea robertsi</u>
10.2	0	20.2	0	<u>Pseudoeurycea smithi</u>
11.8	0	22.2	0	<u>Pseudoeurycea unquidentis</u>
10.8	0	12.4	0	<u>Thorius dubitus</u>
10.4	0	21.2	0	<u>Thorius narisovalis</u>
23.0	0	23.0	0	<u>Thorius pennatus</u>
18.0	0	21.4	0	<u>Thorius pulmonaris</u>
10.2	0	13.8	0	<u>Thorius macdougalli</u>
10.1	0	14.0	0	<u>Thorius troglodytes</u>
<b>Tropical ambystomatids:</b>				
16.0	1	29.0	0	<u>Ambystoma amblycephalum</u>
14.3	1	25.0	0	<u>Ambystoma dumerili</u>
18.0	1	23.0	0	<u>Ambystoma flavipiperatum</u>
16.0	1	18.0	0	<u>Ambystoma granulosum</u>
28.0	0	28.0	0	<u>Ambystoma lermaensis</u>
20.0	1	20.0	1	<u>Ambystoma mexicanum</u>
11.8	0	18.0	0	<u>Ambystoma ordinarium</u>
13.0	1	30.0	0	<u>Ambystoma rosaceum</u>
15.0	1	15.0	1	<u>Ambystoma subsalsum</u>

10.5	1	26.0	0	<u>Ambystoma tigrinum</u>
15.0	1	20.5	0	<u>Ambystoma 'zacapu'</u>
14.0	0	14.0	0	<u>Rhyacosiredon altimirani</u>
11.0	1	11.0	1	<u>Rhyacosiredon rivularis</u>

## Temperate plethodontids:

11.1	0	22.0	0	<u>Aneides aeneus</u>
16.8	0	20.5	0	<u>Aneides ferreus</u>
02.2	1	18.5	0	<u>Aneides flavipunctatus</u>
14.5	0	14.5	0	<u>Aneides hardii</u>
02.0	1	19.0	0	<u>Aneides lugubris</u>
02.2	1	15.8	1	<u>Batrachoseps attenuatus</u>
04.0	1	22.0	0	<u>Batrachoseps pacificus</u>
06.8	1	07.5	1	<u>Batrachoseps nigriventris</u>
08.0	0	08.0	0	<u>Batrachoseps wrighti</u>
01.0	1	22.0	0	<u>Desmognathus fuscus</u>
02.0	1	20.0	0	<u>Desmognathus monticola</u>
02.0	1	20.0	0	<u>Desmognathus ochrophaeus</u>
01.0	1	20.0	0	<u>Ensatina eschscholtzii</u>
01.0	1	20.0	0	<u>Eurycea bislineata</u>
08.0	1	22.0	0	<u>Eurycea longicauda</u>
08.0	1	22.0	0	<u>Eurycea lucifuga</u>
00.0	1	21.0	0	<u>Eurycea multiplicata</u>
26.2	0	26.3	0	<u>Eurycea quadridigitatus</u>
12.0	0	12.0	0	<u>Gyrinophilus palleucus</u>
05.0	0	16.0	0	<u>Gyrinophilus porphyriticus</u>
12.2	1	12.2	0	<u>Hydromantes shastae</u>
-2.0	1	11.5	0	<u>Hydromantes platycephalus</u>
11.6	0	22.8	0	<u>Plethodon caddoensis</u>
03.0	1	22.0	0	<u>Plethodon cinereus</u>
11.4	0	13.0	0	<u>Plethodon dorsalis</u>
09.2	0	13.0	0	<u>Plethodon dunni</u>
12.2	0	19.5	0	<u>Plethodon glutinosus</u>
17.0	0	19.2	0	<u>Plethodon huldae</u>
13.5	0	20.5	0	<u>Plethodon metcalfi</u>
10.5	0	13.0	0	<u>Plethodon neomexicanus</u>
15.2	0	21.4	0	<u>Plethodon ouchitae</u>
15.2	0	17.1	0	<u>Plethodon welleri</u>
06.0	0	06.0	0	<u>Plethodon vandykei</u>
09.2	0	12.5	0	<u>Plethodon vehiculum</u>
22.0	0	22.0	0	<u>Typhlomolge rathbuni</u>

## Temperate non-plethodontids:

07.0	1	23.7	1	<u>Ambystoma cingulatum</u>
01.0	1	22.3	0	<u>Ambystoma jeffersonianum</u>
06.0	1	07.8	1	<u>Ambystoma platineum</u>
04.0	1	19.0	1	<u>Ambystoma talpoideum</u>
03.4	1	25.0	0	<u>Ambystoma macrodactylum</u>
01.0	1	32.0	0	<u>Ambystoma maculatum</u>
07.0	1	24.0	0	<u>Ambystoma opacum</u>
02.5	1	04.5	1	<u>Ambystoma texanum</u>
02.0	1	26.5	0	<u>Ambystoma tigrinum</u>
24.0	0	24.0	0	<u>Amphiuma means</u>
09.8	1	28.0	0	<u>Cryptobranchus alleganiensis</u>
09.2	0	16.2	0	<u>Dicamptodon ensatus</u>
07.8	1	27.8	0	<u>Notophthalmus viridescens</u>

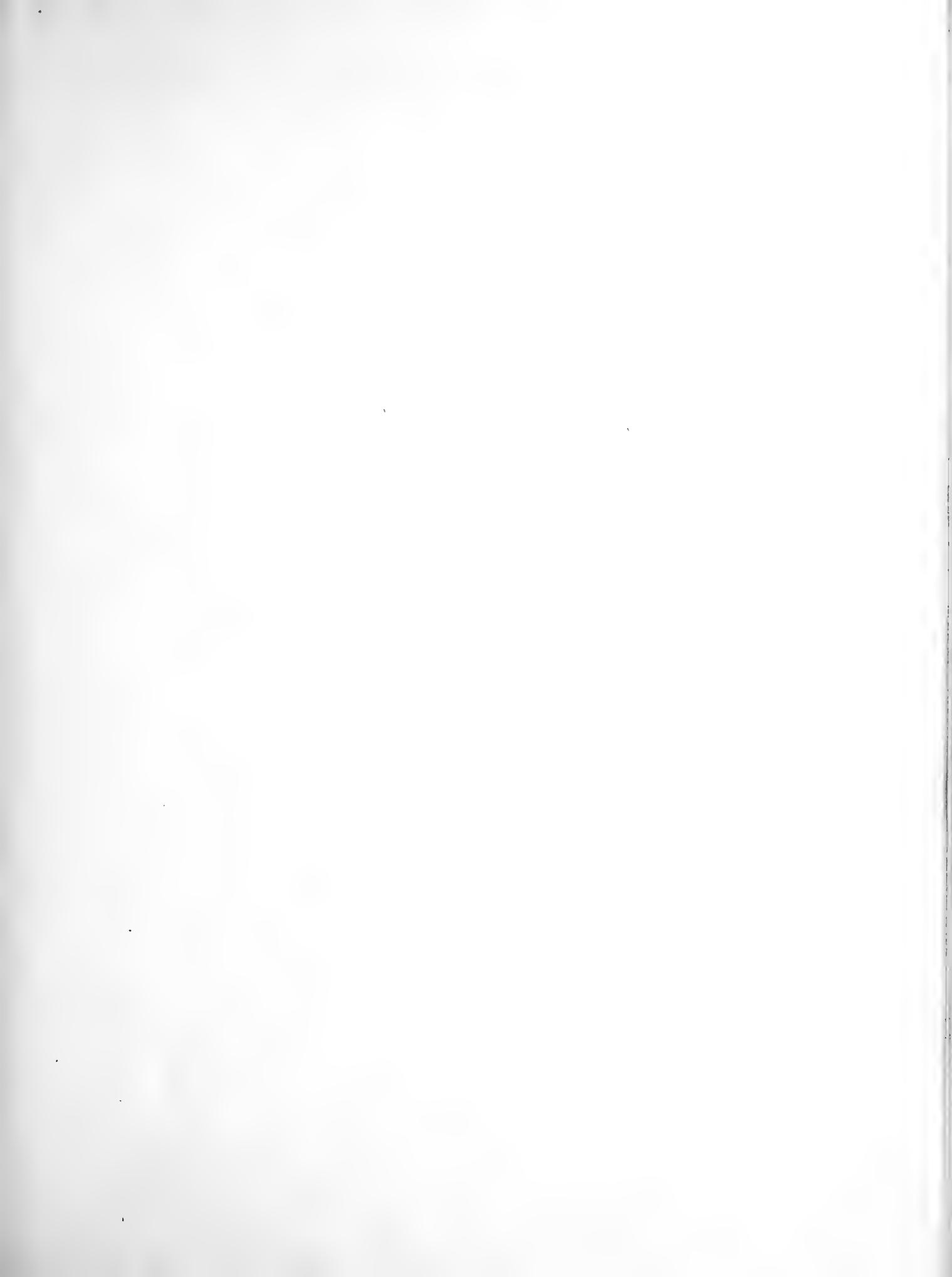
08.0	1	26.0	0	<u>Pseudobranchus striatus</u>
05.8	0	09.6	0	<u>Rhyacotriton olympicus</u>
13.3	0	16.0	0	<u>Salamandra salamandra</u>
08.0	1	26.0	0	<u>Siren intermedia</u>
08.0	1	26.0	0	<u>Siren lacertina</u>
04.5	1	18.4	0	<u>Taricha granulosa</u>
09.0	1	26.0	0	<u>Taricha rivularis</u>
13.3	0	18.3	0	<u>Taricha torosa</u>

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THREE NEW SPECIES OF REPTILES  
FROM  
HAINAN ISLAND, GUANGDONG PROVINCE

Translation and Introduction  
by  
AKIHIRO KOSHIKAWA

SMITHSONIAN  
HERPETOLOGICAL INFORMATION  
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## Introduction

According to a handbook titled "Synopsis of Reptiles of China" (1977)<sup>1</sup> 326 species and subspecies of reptiles are known from China. Comparison of this figure to that given by Clifford H. Pope in 1935<sup>2</sup> (218 taxa) indicates a great advance of herpetofaunal investigation in China, most of which was carried out by their own people in the latter half of this century. A series of well-organized herpetofaunal researches has resulted in many published reports (and still many more seem to await publication); these include new geographical records and descriptions of new forms. Most of these herpetological reports appeared in journals such as ACTA ZOOLOGICA SINICA and ACTA ZOOTAXONOMICA SINICA. Recently a purely herpetological journal was initiated by Chengdu Institute of Biology (Acta Herpetologica Sinica) which will be a stepping stone for the further advance of herpetology in China.

Many herptiles are valuable natural resources in China and their importance in economics (food, medicine, leather, etc.) is well documented in a recently published booklet, "Economic Herptiles".<sup>3</sup> This booklet stresses the importance of further investigation of distribution and ecology of herptiles to take necessary conservational measures including captive propagation. Snakebite is another aspect of herpetology for which a well-edited handbook is available. This handbook, "Chinese Poisonous Snakes and Treatment of Their Bites"<sup>4</sup> contains many interesting accounts of venomous snakes of China as well as very unique herbal medication for snakebites. These two areas of para-herpetology seem to have played an important role in the advancement of their researches on various aspects of these animals in China.

The following is a translation of one of these reports, mentioned above; it appeared in the Acta Zoologica Sinica (24(4):379-384 + pl., 1975). Before presenting the translation, I wish to offer a few comments:

- 1) The introductory part of the text as well as "types" and "diagnosis" are directly transcribed from the original English summary with a minor addition.
- 2) Terminology used for morphological description is mainly based on James A. Peters' "Dictionary of Herpetology"<sup>5</sup> except the "interoccipitals" which in this paper is used to describe a group of small scales behind the parietals and separating the posterior temporals. Peters mentions the use of this term in saurians and in scolecophidian snakes but not in colubrid snakes such as Achalinus. The Chinese name for this scale, Jian zhen ban, however, seems to be seldom used and is not mentioned in the section on snake lepidosis in "Synopsis of Reptiles of China".
- 3) Sichuan Biological Research Institute is now called "Chengdu Institute of Biology, Academia Sinica". This must be the largest center of herpetology in China.
- 4) The author of X. hainanensis and D. rosazonatum, Diao, is written as Zhao (Zhao Ermi) in recent papers.
- 5) Xenopeltis hainanensis is now known also from Longsheng prefecture (ca. 25° 42'N, 110°-01'E) of Guangxi Zhuang Autonomous Province (=Kwangsi) and Longquan area (ca. 28° 04'N, 199° 07'E) of Zhejiang Province (=Chekiang).

(Specimens in Guangxi Medical College and Zhejiang Province Museum respectively. "Synopsis of Reptiles of China", p. 51. Geographical locations are after Rand McNally International Atlas, 1979.)

- 6) Dinodon rosazonatum is illustrated by a color photograph and described in a short text in "Chinese Poisonous Snakes and Treatment of Their Bites" as a snake which is occasionally misconceived to be poisonous. The first edition of the book was published in 1974, one year before the "original description". Description of this snake (page 108 of the first edition and page 114 of the second edition) is translated as follows:

Fen Lian She Dinodon rosazonatum Hu et Diao (Color plate 26)  
 Local name: Huo Jia She  
 Belongs to the same genus and family as Chi Lian She (=Dinodon rosazonatum: Red Chain-snake) and Huang Lian She (=D. septentrionalis: Yellow Chain-snake); Genus Dinodon, subfamily Colubrinae and Family Colubridae. Nonpoisonous. Distinguished from the latter two species in having 19-17(15) dorsal scale rows, 221-234 ventrals and relatively fewer number 28-33 and 9-13) of pinkish red cross bands. Found on plains and mountains along streams below 600 meters above sea level. Presently only known from Hainan Island, where people consider the snake to be a close relative of Bungarus fasciatus and poisonous.

In the second edition of the book this snake is described in Chapter 3 which is written by Hu and Zhao. However, in the first edition, the authors of each chapter are not credited. I wish to thank Showichi Sengoku who drew my attention to this fact.

- 7) "Chestnut brown" used in the description of Cuora hainanensis is translated from "zong he se". It is possible that "zong he se" is a little darker than chestnut brown. I could not find any literature in which this color is well explained.
- 8) The number of taxa of reptiles known from Hainan Island is here given as 108; however, I could count only 104 species and subspecies in the distribution table of "Synopsis of Reptiles of China" (p. 77-93).

I wish to express my sincere gratitude to Mr. Showichi Sengoku of Japan Wildlife Research Center for his help and encouragement throughout the preparation of this text.

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- 4) Chengdu Institute of Biology, Museum of Natural History of Shanghai, Zhejiang Province Institute of Chinese Medicine et al., (eds.). 1979. Zhongguodedushe ji sheshangfangzhi (Chinese Poisonous Snakes and Treatment of Their Bites). Shanghai kasuejushue chuban sha, Shanghai (In Chinese). (First edition published in 1974 by Shanghai renmin chuban sha.)
- 5) Peters, J.A. 1964. Dictionary of Herpetology. Hafner Publishing Company, New York and London.

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Three New Species of Reptiles from Hainan Island,  
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From 1963 to 1964, three herpetological explorations were carried out in Hainan Island, Guangdong Province. Up to the present, 108 species and subspecies of reptiles belonging to 61 genera, 18 families and 3 orders have been recorded from Hainan Island. Among the reptiles recorded in China, only crocodilians, Anguidae and Xenosauridae of the saurians have so far not been found on this island. The reptilian fauna of Hainan Island consists mainly of Oriental forms. Among these, the species which are generally distributed in South China predominate. Many reptiles are endemic to the island. Zoogeographically, Hainan Island has been classified as a subregion of the South China Region. Hainan reptiles comprise one-fifth of the entire Chinese reptile fauna.

In the following, three new species, one new taxonomic revision and three species new to China are described.

1. *Xenopeltis hainanensis* Hu et Djao, sp. nov. (Fig. 1a, b, c)\*  
(New Chinese Name: Hainan Shan Lin She, Brilliant scaled snake of Hainan)

**TYPES:** Holotype, an adult male (SBRI No. 64III6016; June 15, 1964; Dali of Diaulo Shan, Hainan, altitude 200 m); allotype, an adult female (SBRI no. 64III6650; September 4, 1964; Yacha Matou, Baisa Hsien, Hainan altitude 217 m).

**DIAGNOSIS:** This new species distinctly differs from *Xenopeltis unicolor* Reinwardt, the monotype of the genus *Xenopeltis*, in having 22-24 maxillary teeth on each maxilla; one postocular; seven upper labials, the fourth and fifth of which enter the eye; 152-157 ventrals and 16-18 pairs of subcaudals.

**DESCRIPTION:** The measurement and scale counts of the two type specimens are shown in Table 1. Head relatively small, somewhat depressed; snout round and robust, body cylindrical; tail short, about 1/13 to 1/14 of the total length. Hemipenis thick and short, with longitudinal sulcuses, no spines. When alive, back is indigo brown and has metallic luster; two series of white longitudinal spots between D1 and D3; D1 grayish white with indigo brown base. Underside of the head light indigo gray or light brown; underside of the body and the tail's base grayish white; other part of the tail's underside indigo brown.

**HABIT:** Allotype was collected among grasses, under a basket of young pineapple plants near a harbor at 0800 hours. It was found when a basket was moved.

**DISCUSSION:** For almost 100 years, *Xenopeltis unicolor* Reinwardt, which is widespread in Southeast Asia and also recorded from Yunnan in China, has been the sole member of the family Xenopeltidae. This species has 35 to 45 maxillary teeth on each maxilla; two postoculars; eight upper labials with the fourth and fifth entering the eye; 164 to 196 ventrals and 22 to 31 subcaudals. The new species is sufficiently distinct from the former form.

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\* Figures are not reproduced herein. Please see original article. (SHIS ed.)

2. Dinodon rosazonatum Hu et Djao, sp. nov. (Fig. 2)  
 (New Chinese Name: Fen Lian She, Pink Chain-Snake. Lian She (Chain-Snake) is common name for Dinodon sp.)

TYPES: Holotype, an adult male (SBRI No. 64III6089; June 21, 1964; Dali of Diaulo Shan, Hainan, altitude 200 m); allotype, an adult female (SBRI No. 64III5246; May 11, 1964; Wuzhi Shan, Hainan altitude 540 m); paratypes 3 males and 5 females (1964-1972, Diaulo Shan, Wuzhi Shan and Haidou, altitude 80-580 m).

DIAGNOSIS: This new species differs from all of the known species of the genus Dinodon by having the composite characters: 1) dorsal scales in 19-19-15(17) rows, the vertebral row distinctly more enlarged than the adjacent scale rows; 2) more ventrals (221-234); 3) blackish brown above, crossed by 28-35 + 9-13 narrow pink bands.

DESCRIPTION: Based upon four male and six female specimens of type series. Each maxilla has 12 to 13 teeth which are divided into three groups by diastemas with the dental formula of 6(7) + 3 + 3, the first group teeth gradually enlarge, the middle group smaller and the last group the largest. Loreal single, very small, entering the eye in one specimen; single preocular, which is absent on the left side in one specimen; two postoculars; two anterior temporals, exceptionally united into one piece; three posterior temporals, exceptionally two; eight upper labials with 2-3-3 formula, sometimes 3-2-2 on one side. Dorsal scales in 19-19-15(17) rows, with weak keels on three to nine middle rows. Length of the male specimen 850 + 210 mm (holotype) and that of the female 802 + 174 mm (allotype).

When alive, back is blackish brown with 28-35 + 9-13 pink cross bands on body and tail; each cross band width is equal to one to two dorsal scales, and each cross band bifurcates at D5 or D6 and reaches ventrals, but those on posterior part of the tail do not show clear bifurcation, on those cross bands are more or less scattered blackish brown flecks; on the neck is "A"-shaped pink marking whose anterior end reaches the parietals and posterior ends reach the rictuses; upper labials pinkish brown and the seam between them black; series of intermittent narrow black stripes from the parietal seam and the temporals to the upper labial edge. Underside of the head whitish with a few blackish brown spots; the first quarter of the underside of the body grayish white, the remaining part with blackish brown blotches, underside of the tail predominantly blackish brown.

HABIT: Found in the hills and on the plain along streams and around rice paddies at altitudes of less than 850 m. Usually comes out at dusk or at night. The allotype was captured at 1020 hours in the hole of a large tree trunk about 1.5 m above ground. Her head was seen a few centimeters out of the hole, and she was captured when baited out by a live frog. This snake was observed to eat a green pit-viper (Zu Ye Qing = Trimeresurus stejnegeri) which was kept in the same cage in September, 1972.

NOTE: The Wildlife Retail Department of Haikou City has been supplying this snake for food. The snake is called "Huo Jia She" (meaning fire-armored snake) and considered to be a close relative to the banded krait (Bungarus fasciatus). But it does not have any venom.

3. Achalinus hainanus Huang, sp. nov. (Fig. 3a, b, c)  
 (New Chinese Name: Hainan Ji She; Vertebral or Back Snake of Hainan. Ji She (back snake) is common name for Achalinus sp.)

TYPES: Holotype, an adult female (IZAS No. 1076; January 20, 1964; Chien Fung Ling, Hainan, altitude 800 m); paratype, an adult female (IZAS No. 1016; January 16, 1964; from the same locality as the holotype).

**DIAGNOSIS:** This new species is similar to Achalinus rufescens Boulenger, but differs from the latter in having only one anterior temporal, in the upper tertiary temporals directly contacting each other mesially without an inter-occipital, and in having more ventrals (165-168).

**DESCRIPTION:** Table 2 summarizes measurements and scale counts of the two type specimens. The seam between the internasals as long as that between the prefrontals; parietals long, which anterolaterally enter between the supraocular and the temporals, and may or may not reach the upper-posterior edge of the eye; the eye small, the pupil almost circular; the temporals in three rows, 1 + 2 +3, but four posterior temporals on the right side of the holotype. The uppermost posterior temporals in great contact with the parietals, and are not separated by the interoccipital; upper labials gradually enlarge from front to back and the sixth the longest, longer than five anterior scutes combined; five lower labials with three anterior pairs in contact with the anterior chin shield, two pairs of chin shields of the same size, almost rectangular in shape; dorsal scales evenly keeled except smooth D1 scales; the anal single.

In preservative, snout tip and dorsal aspect of the head indigo gray, temporal region, the edges of the upper and lower labials brownish gray; dorsal aspects of body and tail lighter than that of the head; belly grayish white, with the base of each ventral scale darker; entire body has metallic luster.

**DISCUSSION:** Smith (1923) described Achalinus meridianus based on Hainan specimen. This was the first record of an Achalinus from the island. Major characteristics of the species are 2+2 temporals, suture between the prefrontals are twice as long as that of the internasals, 147 ventrals and 77 subcaudals. Pope (1935) and Bourret (1936) synonymized Hainan Achalinus with A. rufescens. This new species is distinct from all the known specimens of Achalinus from Hainan in the number of the anterior temporals and in the absence of inter-occipitals. These two characters of the present species distinguish it from all other species of the genus. They have two anterior temporals and inter-occipitals on the posterior end of the parietals.

#### 4. Cuora hainanensis (Li), new taxonomic position.

Li described Cyclemys flavomarginata hainanensis (Chinese Journal of Zoology, 2(4):234, 1958) which is now considered as a full species and a member of the genus Cuora. Description of the types is as follows:

**TYPES:** Holotype, an adult male (FU No. 200; Dali of Diaulo Shan, Hainan, altitude 200 m); allotype, an adult female (SBRI No. 64III6110; June, 1964; Nanxi of Diaulo Shan, Hainan, altitude 82 m); paratypes 3 males and 4 females (1963-1964, Diaulo Shan and Chien Fung Ling, Hainan).

**DIAGNOSIS:** This new species is similar to Cuora flavomarginata (Gray), but differs from the latter by: 1) snout more pointed, its tip projecting beyond the upper jaw; 2) the margin of the upper jaw straight, without hook; 3) hinder part of the head covered with small scales; 4) anterior three vertebral (= central) shields projecting medially in front and with a medial notch behind; 5) anal shield single, without any rudiment of median suture; and 6) a different color pattern.

**DESCRIPTION:** Size of the nine type specimens are listed in Table 3. Carapace relatively high, vertebral ridge on the midline; no distinct emargination in front and back, slight outward curvature of the carapacial edge in front and back, no serration of margin. Nuchal very small; vertebrals as broad and long, each narrower than its adjacent pleurals, anterior three vertebrals projecting

medially in front, two anterior vertebrals have notches behind.\* Each carapacial shield has indistinct concentric pattern. Plastron relatively wide and flat, front and hind edges round and not emarginated, connected to the carapace by ligaments, ligament between pectoral and abdominal, front and hind halves can close to the carapace; no distinct bridges, no axillary nor inguinal; abdominal seam longest, humeral seam shortest; anal single without any seam nor rudiment of it. Head moderate, snout obtusely pointed, slightly projecting beyond the upper beak; top of the head smooth, occipital region with small scales; orbit as long as snout; upper beak edge smooth, not notched nor hooked, lower beak slightly shorter than the upper beak. Limbs moderate, covered with relatively large imbricate scales, the largest scales on the back of the forelimb, upper arm and heel covered with few large scales; five claws on forelimb and four claws on the hindlimb, fingers and toes half-webbed. Tail relatively short, long-conical in shape and covered with hard scales.

When alive, back light yellow, middle (vertebrals and adjacent part of pleurals) and edges (cervical, dorsal surface of marginals, and postcentrals) chestnut brown; light yellow area has brushed stripes or spots or chestnut brown, chestnut brown area, on the other hand, has few light yellow stripes, the midline on the vertical keel is also light yellow. Ventral surface of marginals is a mixture of chestnut brown and light yellow. Plastron chestnut brown with few irregularly scattered light yellow spots. Top of the head olive, chestnut brown spots on snout, occipital part, cheeks and upper beak, light yellow tympanic membrane, lower beak and throat grayish white. Neck light yellow with blackish brown bands on the outer side; hindlimbs grayish brown on the back and light yellow below. Tail light yellow with blackish brown blotches.

HABIT: Found at mountain streams, this turtle's habitat is completely different from that of Cuora flavomarginata which is mainly found along pond banks or in rice paddies.

5. Acanthosaura armata armata (Hardwicke et Gray) (Agamidae)

Newly recorded from China.

One male, January 20, 1964, Chien Fung Ling, Hainan, altitude 750-850 m. Postocular spiny scales and beard like spiny scales on the throat are relatively long, as long as the eye's diameter.

6. Calotes microlepis Boulenger (Agamidae)

Newly recorded from China.

Two males and one female, April 30, 1963 to January 17, 1964, Wushi Shan, 580 m, and Chien Fung Ling, 750 m, Hainan.

Keels on the scales on the side of the body are directed posteroventrally, no shoulder fold, hindlimb reaches shoulder when adpressed against the body, 60 to 70 scale rows around the midbody.

7. Bungarus niger Wall (Elapidae)

Newly recorded from China.

One female, October 12, 1964, bought at Haikou City's Wildlife Retail Department.

\* Translator's Note: This account on the notches of vertebral shields disagrees with that of DIAGNOSIS which says the three anterior vertebrals have notches behind. However, it is almost certain that the third vertebral does not have any notch behind because medial projection of the fourth vertebral is not mentioned in the DIAGNOSIS nor the DESCRIPTION.

Back blackish brown, belly white, interrupted series of black and white blotches on the side. Total length 1320 mm, tail length 154 mm. 215 ventrals and 50 subcaudals.

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Translator's Note: This scientific article follows the current Chinese policy of crediting authorship to the institutions where the research was performed. However, to comply with standard nomenclatural practice, new scientific names are credited to individual scientists.

Specimens	Total Length (mm)	Tail Length (mm)	Dorsal Scales	Ventral Scales	Sub-Caudal Scales	Upper Labial Scales	Anal Scales	Maxillary Teeth
Holotype ♂ SBRI 66III6016	628	49	15-15-15 smooth	152	18 paired	3-2-2	2	24
Allotype ♀ SBRI 64III6650	521	38	15-15-15 smooth	157	16 paired	3-2-2	2	22

Table 1.

Xenopeltis hainanensis

Holotype ♀ IZAS 1016	290	77	23-23-23	165	67 single	3-2-1
Paratype ♀	310	80	23-23-23	168	69 single	3-2-1

Table 2.

Achalinus hainanus

Carapace Length (mm)	Carapace Width (mm)	Shell Height (mm)
Holotype ♂ FU 200	160	111
Allotype ♀ SBRI 64III6110	136	101
Paratypes 3 ♂♂; 4 ♀♀	83-186	68-129

Table 3.

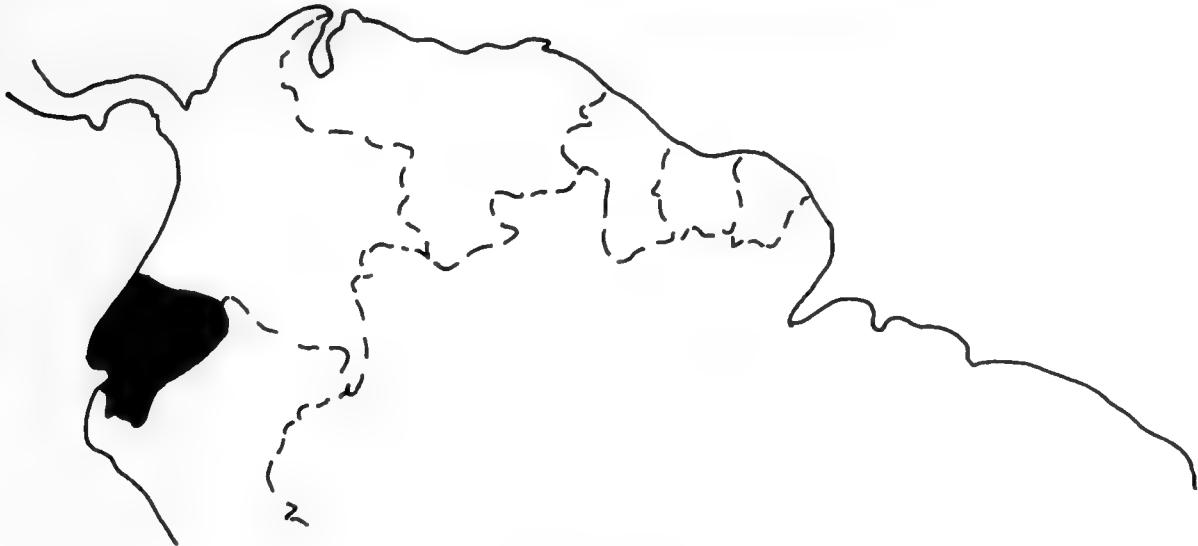
Cuora hainanensis





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A CHECK LIST OF THE AMPHIBIANS AND REPTILES OF ECUADOR  
WITH  
A BIBLIOGRAPHY OF ECUADORIAN HERPETOLOGY



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SMITHSONIAN  
HERPETOLOGICAL INFORMATION  
SERVICE  
NO. 54

1982



## INTRODUCTION

There has been a renewed interest in the herpetology of Ecuador over the past twenty years, initiated largely through the efforts of the late Dr. James A. Peters. During this period large collections of Ecuadorian material have been made by a number of workers and this material is now deposited in North American collections, notably the University of Kansas Museum of Natural History, the United States National Museum of Natural History, and the Museum of Comparative Zoology. These collections have shown that the Ecuadorian herpetofauna is exceptionally rich, and until now a complete checklist has not been available.

As is the case with any checklist, this is very much a work-in-progress. Of the 682 taxa recorded herein from Ecuador, 136 have been described since 1970, and I am aware of many more species awaiting description. There is no shortage of basic exploratory work yet to be done. Although most of the major habitats and regions have been sampled, there still remain large blank areas on collecting maps that will no doubt turn up many surprises. I have made efforts to check out suspicious literature records, but in some cases species may be included on this list due to either misidentifications or incorrect locality data.

I chose not to include information on distribution in this list for two reasons. The distributions of many species are poorly known, and many species appear to have extremely restricted ranges. A simplified notation of distribution would be misleading because it would imply that distributions are well known even when they are not. Also, many of the older records, both in the literature and in collections, are suspect, and if these taxa are not well represented in recent collections it is not possible to make realistic estimations of distribution. I have made every effort to eliminate these, but some no doubt remain. Field work in Ecuador has characteristically been exploratory, and only a few localities have been sampled adequately. More faunal work concentrating on specific areas is needed, and this work is probably best done by resident naturalists.

The bibliography is a current (to March 1982) and fairly comprehensive guide to the systematic literature on the Ecuadorian herpetofauna. It contains all references to original descriptions of Ecuadorian taxa, as well as ecological and systematic papers that mention Ecuadorian specimens. This latter coverage is incomplete, but I believe that the bibliography includes most references likely to be useful to any student of the Ecuadorian herpetofauna. I relied heavily on Vanzolini's bibliography of South American reptiles (1978) for locating references on reptiles, and his comments on many of the older papers, should be consulted before any great effort is made to locate obscure papers.

I hope that publication of this list and bibliography will stimulate interest in the enormously diverse Ecuadorian herpetofauna. In many respects Ecuador is a microcosm of tropical South America, and students of amphibian and reptile biology are sure to find much of interest there.

## ACKNOWLEDGEMENTS

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## AMPHIBIA

ANURA

## BUFONIDAE

- Atelopus arthuri* Peters 1973  
 A. *balios* Peters 1973  
 A. *bomolochos* Peters 1973  
 A. *boulengeri* Peracca 1904  
 A. *coynei* Miyata 1980a  
 A. *elegans* (Boulenger 1882a)  
 A. *halihelos* Peters 1973  
 A. *ignescens* (Cornalia 1849)  
 A. *longirostris* Cope 1868  
 A. *lynchi* Cannatella 1981  
 A. *mindoensis* Peters 1973  
 A. *nepiozomus* Peters 1973  
 A. *pachydermus* (O. Schmidt 1857)  
 A. *palmatus* Andersson 1945  
 A. *planispinus* Jiménez de la Espada 1875  
 A. *pulcher pulcher* (Boulenger 1882a)  
*Bufo blombergi* Myers and Funkhouser 1951  
 B. *caeruleoocellatus* Fowler 1913  
 B. *caeruleostictus* Günther 1859d  
 B. *ceratophrys* Boulenger 1882a  
 B. *chanchanensis* Fowler 1913  
 B. *coniferus* Cope 1862a  
 B. *dapsilis* Myers and Carvalho 1945  
 B. *glaberrimus* Günther 1868  
 B. *haematiticus* Cope 1862a  
 B. *marinus* (Linnaeus 1758)  
 B. *spinulosus* Wiegmann 1835  
 B. *typhonius* (Linnaeus 1758)  
*Dendrophryniscus minutus* Melin 1941  
*Osornophryne bufoniformis* (Peracca 1904)  
*Rhamphophryne festae* (Peracca 1904)

## CENTROLENIDAE

- Centrolene geckoideum* Jiménez de la Espada 1872  
*Centrolenella anomala* Lynch and Duellman 1973  
 C. *audax* Lynch and Duellman 1973  
 C. *balionota* Duellman 1981  
 C. *buckleyi* (Boulenger 1882a)  
 C. *cochranae* (Goin 1961a)  
 C. *flavopunctata* Lynch and Duellman 1973  
 C. *fleischmanni* (Boettger 1893)  
 C. *grandisonae* Cochran and Goin 1970  
 C. *griffithsi* (Goin 1961a)  
 C. *heloderma* Duellman 1981

- Centrolenella lynchi* Duellman 1980  
 C. medemi Cochran and Goin 1970  
 C. megacheira Lynch and Duellman 1973  
 C. midas Lynch and Duellman 1973  
 C. munozorum Lynch and Duellman 1973  
 C. ocellifera (Boulenger 1899c)  
 C. pellucida Lynch and Duellman 1973  
 C. peristicta Lynch and Duellman 1973  
 C. pipilata Lynch and Duellman 1973  
 C. prosoblepon (Boettger 1892)  
 C. resplendens Lynch and Duellman 1973  
 C. siren Lynch and Duellman 1973  
 C. spiculata Duellman 1976  
 C. spinosa Taylor 1949  
 C. valerioi (Dunn 1931)

## DENDROBATIDAE

- Colostethus anthracinus* Edwards 1971  
 C. bocagei (Jiménez de la Espada 1871)  
 C. brunneus (Cope 1887)  
 C. elachyhistus Edwards 1971  
 C. fuliginosus (Jiménez de la Espada 1871)  
 C. infraguttatus (Boulenger 1898a)  
 C. intermedius (Andersson 1945)  
 C. kingsburyi (Boulenger 1918)  
 C. latinus (Cope 1863)  
 C. marchesianus (Melin 1941)  
 C. pratti (Boulenger 1899a)  
 C. pulchellus (Jiménez de la Espada 1871)  
 C. sauli Edwards 1974  
 C. taeniatus (Andersson 1945)  
 C. vertebralis (Boulenger 1899b)  
 C. whymperi (Boulenger 1882a)  
*Dendrobates abditus* Myers and Daly 1976a  
 D. anthonyi (Noble 1921)  
 D. boulengeri (Barbour 1909)  
 D. erythromos Vigle and Miyata 1980  
 D. espinosai (Funkhouser 1956)  
 D. femoralis (Boulenger 1883a)  
 D. histrionicus (Berthold 1846a)  
 D. parvulus Boulenger 1882a  
 D. pictus (Bibron in Tschudi 1838)  
 D. quinquevittatus Steindachner 1864  
 D. tricolor (Boulenger 1899b)  
 D. trivittatus (Spix 1824a)  
 D. zaparo (Silverstone 1976)

## HYLIDAE

- Agalychnis calcarifer* Boulenger 1902b  
A. *craspedopus* (Funkhouser 1957)  
A. *litodryas* (Duellman and Trueb 1967)  
A. *spurrelli* (Boulenger 1912)  
*Amphignathodon guentheri* Boulenger 1882a  
*Gastrotheca angustifrons* (Boulenger 1898a)  
G. *cavia* Duellman 1974a  
G. *cornuta* (Boulenger 1898a)  
G. *humbertoi* Lutz 1977  
G. *lojana* Parker 1932  
G. *longipes* (Boulenger 1882a)  
G. *monticola* Barbour and Noble 1920  
G. *orophylax* Duellman and Pyles 1980  
G. *plumbea* (Boulenger 1882a)  
G. *psychrophila* Duellman 1974a  
G. *riobambae* (Fowler 1913)  
G. *testudinea* (Jiménez de la Espada 1871)  
G. *weinlandii* (Steindachner 1892)  
*Hemiphractus bubalus* (Jiménez de la Espada 1871)  
H. *fasciatus* Peters 1862b  
H. *johsoni* (Noble 1917)  
H. *proboscideus* (Jiménez de la Espada 1871)  
H. *scutatus* (Spix 1824a)  
*Hyla alboguttata* Boulenger 1882a  
H. *albopunctulata* Boulenger 1882a  
H. *alytolylax* Duellman 1972b  
H. *bifurca* Andersson 1945  
H. *boans* (Linnaeus 1758)  
H. *bokermanni* Goin 1960  
H. *brevifrons* Duellman and Crump 1974  
H. *calcarata* Troschel 1848  
H. *carnifex* Duellman 1969b  
H. *columbiana* Boettger 1892  
H. *crepitans* Wied-Neuwied 1824  
H. *fasciata* Günther 1859a  
H. *favosa* Cope 1885  
H. *geographica* Spix 1824a  
H. *granosa* Boulenger 1882a  
H. *gryllata* Duellman 1973a  
H. *lanciformis* lanciformis (Cope 1871a)  
H. *larinopygion* Duellman 1973a  
H. *leucophyllata* (Beireis 1783)  
H. *lindae* Duellman and Altig 1978  
H. *marmorata* (Laurenti 1768)  
H. *minuta* Peters 1872a  
H. *parviceps* Boulenger 1882a  
H. *pellucens* Werner 1901  
H. *phyllognatha* Melin 1941  
H. *picturata* Boulenger 1882a

- Hyla punctata* Schneider 1799  
*H.* *rhodopepla* Günther 1859a  
*H.* *riveroi* Cochran and Goin 1970  
*H.* *rosenbergi* Boulenger 1898a  
*H.* *rossalleni* Goin 1957  
*H.* *sarayacuensis* Shreve 1935  
*H.* *torrenticola* Duellman and Altig 1978  
*H.* *triangulum* Günther 1869  
*H.* *tuberculosa* Boulenger 1882a  
*Nyctimantis rugiceps* Boulenger 1882a  
*Oolygon cruentomma* (Duellman 1972a)  
*O.* *funerea* (Cope 1874)  
*O.* *garbei* (Miranda-Ribeiro 1924)  
*O.* *quinquefasciata* (Fowler 1913)  
*O.* *rubra* (Daudin 1802)  
*O.* *sugillata* (Duellman 1973a)  
*Osteocephalus buckleyi* (Boulenger 1882a)  
*O.* *lepraeurii* (Duméril and Bibron 1841)  
*O.* *taurinus* Steindachner 1862  
*O.* *verrucigerus* (Werner 1901)  
*Phrynohyas coriacea* (Peters 1867)  
*P.* *venulosa* (Laurenti 1768)  
*Phyllomedusa buckleyi* (Boulenger 1882a)  
*P.* *palliata* Peters 1872b  
*P.* *perinesos* Duellman 1973a  
*P.* *tarsius* (Cope 1868)  
*P.* *tomopterna* (Cope 1868)  
*P.* *vallanti* Boulenger 1882a  
*Smilisca phaeota* (Cope 1862a)  
*Sphaenorhynchus carneus* (Cope 1868)  
*S.* *dorisae* (Goin 1957)  
*S.* *eurhostus* Rivero 1969  
*Trachycephalus jordani* (Stejneger and Test 1891)

#### LEPTODACTYLIDAE

- Adenomera andreae* (Muller 1923)  
*A.* *hylaedactyla* (Cope 1868)  
*Barycholos pulcher* (Boulenger 1898a)  
*Ceratophrys cornuta* (Linnaeus 1758)  
*C.* *stolzmanni scaphiopeza* Peters 1967a  
*Edalorhina perezi* Jiménez de la Espada 1871  
*Eleutherodactylus achatinus* (Boulenger 1898a)  
*E.* *acerus* Lynch and Duellman 1980  
*E.* *actites* Lynch 1979b  
*E.* *acuminatus* Shreve 1935  
*E.* *altamzonicus* Barbour and Dunn 1921  
*E.* *anomalus* (Boulenger 1898a)  
*E.* *appendiculatus* (Werner 1894b)  
*E.* *atratus* Lynch 1979a  
*E.* *balionotus* Lynch 1979a

*Eleutherodactylus baryecuus* Lynch 1979a  
E. *buckleyi* (Boulenger 1882a)  
E. *cajamarcensis* Barbour and Noble 1920  
E. *calcarulatus* Lynch 1976a  
E. *caprifer* Lynch 1977  
E. *carvalhoi* Lutz in Lutz and Kloss 1952  
E. *celator* Lynch 1976a  
E. *cerastes* Lynch 1975c  
E. *chalceus* (Peters 1873)  
E. *chloronotus* Lynch 1969a  
E. *colodactylus* Lynch 1979a  
E. *condor* Lynch and Duellman 1980  
E. *conspicillatus* (Günther 1858)  
E. *cornutus* (Jiménez de la Espada 1871)  
E. *cremnobates* Lynch and Duellman 1980  
E. *crenunghis* Lynch 1976a  
E. *croceoinguinus* Lynch 1968a  
E. *crucifer* (Boulenger 1899b)  
E. *cruentus* (Peters 1873)  
E. *cryophilus* Lynch 1979a  
E. *cryptomelas* Lynch 1979a  
E. *curtipes* (Boulenger 1882a)  
E. *devillei* (Boulenger 1880)  
E. *diadematus* (Jiménez de la Espada 1875)  
E. *diastema* (Cope 1876a)  
E. *dolops* Lynch and Duellman 1980  
E. *duellmani* Lynch 1980c  
E. *elassodiscus* Lynch 1973b  
E. *eriphus* Lynch and Duellman 1980  
E. *galdi* (Jiménez de la Espada 1871)  
E. *gladiator* Lynch 1976c  
E. *glandulosus* (Boulenger 1880)  
E. *gularis* (Boulenger 1898a)  
E. *helonotus* (Lynch 1975c)  
E. *ignicolor* Lynch and Duellman 1980  
E. *incanus* Lynch and Duellman 1980  
E. *incomptus* Lynch and Duellman 1980  
E. *inusitatus* Lynch and Duellman 1980  
E. *lacrimosus* (Jiménez de la Espada 1871)  
E. *lanthanites* Lynch 1975a  
E. *latidiscus* (Boulenger 1898a)  
E. *leoni* Lynch 1976c  
E. *leucopus* Lynch 1976d  
E. *lividus* Lynch and Duellman 1980  
E. *longirostris* (Boulenger 1898a)  
E. *loustes* Lynch 1979c  
E. *luteolateralis* Lynch 1976c  
E. *lymansi* Barbour and Noble 1920  
E. *malkini* Lynch 1980b  
E. *martiae* Lynch 1974c  
E. *modipeplus* Lynch 1981  
E. *muricatus* Lynch and Miyata 1980

- Eleutherodactylus necerus* Lynch 1975c  
E. *nigrogriseus* (Andersson 1945)  
E. *nigrovittatus* Andersson 1945  
E. *nyctophylax* Lynch 1976a  
E. *ockendeni* (Boulenger 1912a)  
E. *ocreatus* Lynch 1981  
E. *orcesi* Lynch 1972  
E. *orestes* Lynch 1979a  
E. *ornatissimus* (Despax 1911c)  
E. *orphnolaimus* Lynch 1970  
E. *parvillus* Lynch 1976a  
E. *pastazensis* Andersson 1945  
E. *paululus* Lynch 1974c  
E. *percultus* Lynch 1979a  
E. *peruvianus* (Melin 1941)  
E. *petersi* Lynch and Duellman 1980  
E. *phoxocephalus* Lynch 1979a  
E. *prolatus* Lynch and Duellman 1980  
E. *proserpens* Lynch 1979a  
E. *pseudoacuminatus* Shreve 1935  
E. *pugnax* Lynch 1973b  
E. *pycnodermis* Lynch 1979a  
E. *pyrrhomerus* Lynch 1979a  
E. *quaquaversus* Lynch 1974c  
E. *quinquagesimus* Lynch and Trueb 1980  
E. *riveti* (Despax 1911c)  
E. *roseus* (Boulenger 1902b)  
E. *rubicundus* (Jiménez de la Espada 1875)  
E. *ruidus* Lynch 1979a  
E. *sobetes* Lynch 1980c  
E. *spinosus* Lynch 1979a  
E. *subsигillatus* (Boulenger 1902b)  
E. *sulcatus* (Cope 1874)  
E. *supernatis* Lynch 1980a  
E. *surdus* (Boulenger 1882a)  
E. *taeniatus* (Boulenger 1912a)  
E. *tenebrionis* Lynch and Miyata 1980  
E. *thymalopsoides* Lynch 1976a  
E. *thymelensis* Lynch 1972  
E. *trachyblepharis* (Boulenger 1918)  
E. *trepidotus* Lynch 1968b  
E. *unistrigatus* (Günther 1859d)  
E. *variabilis* Lynch 1968a  
E. *ventrimarmoratus* (Boulenger 1912a)  
E. *versicolor* Lynch 1979a  
E. *vertebralis* (Boulenger 1886)  
E. *vidua* Lynch 1979a  
E. *walkeri* Lynch 1974b  
E. *w-nigrum* (Boettger 1892)  
*Ischnocnema quixensis* (Jiménez de la Espada 1872)  
I. *simmonsi* Lynch 1974a  
*Leptodactylus amazonicus* Heyer 1978

*Leptodactylus knudseni* Heyer 1972  
L. *labrosus* Jiménez de la Espada 1875  
L. *melanonotus* (Hallowell 1861)  
L. *pentadactylus* Laurenti 1768  
L. *rhodomystax* Boulenger 1883  
L. *stenodema* Jiménez de la Espada 1875  
L. *ventrimaculatus* Boulenger 1882a  
L. *wagneri* (Peters 1862c)  
*Lithodytes lineatus* (Schneider 1799)  
*Phrynobatrachus brunneus* Lynch 1975b  
P. *flavomaculatus* (Parker 1938)  
P. *peraccae* Lynch 1975b  
*Phyllonastes lochites* (Lynch 1976b)  
*Physalaemus petersi* (Jiménez de la Espada 1872)  
P. *pustulatus* (Shreve 1941)  
*Telmatobius cirrhacelis* Trueb 1979  
T. *niger* Barbour and Noble 1920  
T. *vellardi* Munstermann and Leviton 1959  
*Vanzolinia discodactylus* (Boulenger 1883)

## MICROHYLIDAE

*Chiasmocleis anatipes* Walker and Duellman 1974  
C. *bassleri* Dunn 1949  
C. *ventrimaculata* (Andersson 1945)  
*Ctenophryne geayi* Mocquard 1904  
*Glossostoma aequatoriale* (Peracca 1904)  
G. *aterrimum* Günther 1901  
*Hamptophryne boliviana* (Parker 1927)  
*Synapturanus rabus* Pyburn 1976  
*Syncope antenori* Walker 1973

## PIPIDAE

*Pipa pipa* (Linnaeus 1758)

## RANIDAE

*Rana palmipes* Spix 1824a

CAUDATA

## PLETHODONTIDAE

- Bolitoglossa altamazonica* (Cope 1874)  
B. *chica* Brame and Wake 1963  
B. *ecuatoriana* Brame and Wake 1972  
B. *palmata* (Werner 1897)  
B. *sima* (Vaillant 1911)

APODA

## CAECILIIDAE

- Caecilia abitaguae* Dunn 1942  
C. *albiventris* Daudin 1802  
C. *attenuata* Taylor 1968  
C. *bokermanni* Taylor 1968  
C. *crassisquama* Taylor 1968  
C. *disossea* Taylor 1968  
C. *dunni* Hershkovitz 1938  
C. *nigricans* Boulenger 1902b  
C. *orientalis* Taylor 1968  
C. *pachynema* Günther 1859d  
C. *subterminalis* Taylor 1968  
C. *tentaculata* Linnaeus 1758  
C. *tenuissima* Taylor 1973  
*Microcaecilia albiceps* (Boulenger 1882b)  
*Oscaecilia bassleri* (Dunn 1942)  
O. *equatorialis* Taylor 1973  
*Siphonops annulatus* (Mikan 1820)

## ICHTHYOPHIIDAE

- Epicrionops bicolor* Boulenger 1883b  
E. *marmoratus* Taylor 1968  
E. *petersi petersi* Taylor 1968

## TYPHLONECTIDAE

- Potomotyphlus kaupii* (Berthold 1859)

## REPTILES

CHELONIA

## CHELIIDAE

*Chelus fimbriatus* (Schneider 1783)  
*Phrynapo<sup>s</sup> geoffroanus* *tuberculosa* (Peters 1870)  
P. *gibbus* (Schweigger 1812)  
P. *nasutus* (Schweigger 1812)  
*Platemys platycephala* (Schneider 1792)

## CHELYDRIDAE

*Chelydra serpentina acutirostris* Peters 1862d

## EMYDIDAE

*Rhinoclemmys annulata* (Gray 1860)  
R. *nasuta* (Boulenger 1902b)  
R. *punctularia melanosterna* (Gray 1861)

## KINOSTERNIDAE

*Kinosternon scorpioides scorpioides* (Linnaeus 1758)  
K. *spurrelli* Boulenger 1913b

## PELOMEDUSIDAE

*Podocnemis expansa* (Schweigger 1812)  
P. *unifilis* Troschel 1848

## TESTUDINIDAE

*Geochelone denticulata* (Linnaeus 1758)

CROCODYLIA

## ALLIGATORIDAE

*Caiman crocodilus crocodilus* (Linnaeus 1758)  
*Melanosuchus niger* (Spix 1825)  
*Paleosuchus palpebrosus* (Cuvier 1807)

*Paleosuchus trigonatus* (Schneider 1801)

CROCODYLIDAE

*Crocodylus acutus* Cuvier 1807

SAURIA

ANGUIDAE

*Diploglossus monotropis* (Kuhl 1820)

GEKKONIDAE

*Gonatodes caudiscutatus* (Günther 1859d)  
*G.*           *concinnatus* (O'Shaughnessy 1881)  
*G.*           *humeralis* (Guichenot 1855)  
*Hemidactylus mabouia* (Moreau de Jonnes 1818)  
*Lepidodactylus lugubris* (Duméril and Bibron 1836)  
*Lepidoblepharis buchwaldi* Werner 1910  
*L.*           *festae festae* Peracca 1897  
*L.*           *intermedius* Boulenger 1914  
*L.*           *ruthveni* Parker 1926  
*Phyllodactylus inaequalis* Cope 1876b  
*P.*           *pumilus* Dixon and Huey 1970  
*P.*           *reissii* Peters 1862d  
*Pseudogonatodes guianensis* Parker 1935  
*Sphaerodactylus scapularis* Boulenger 1902b  
*Thecadactylus rapicauda* (Houttuyn 1782)

IGUANIDAE

*Anolis aequatorialis* Werner 1894a  
*A.*           *binotatus* Peters 1863a  
*A.*           *biporcatus parvauritus* Williams 1966  
*A.*           *bitectus* Cope 1864  
*A.*           *bombiceps* Cope 1876b  
*A.*           *chloris* Boulenger 1898a  
*A.*           *chocorum* Williams and Duellman 1967  
*A.*           *chrysolepis scypheus* Cope 1864  
*A.*           *fasciatus* Boulenger 1885  
*A.*           *festae* Peracca 1904  
*A.*           *fraseri* Günther 1859d  
*A.*           *fuscoauratus fuscoauratus* D'Orbigny 1837  
*A.*           *gemmosus* O'Shaughnessy 1875  
*A.*           *gracilipes* Boulenger 1898a  
*A.*           *granuliceps* Boulenger 1898a

*Anolis maculiventris* Boulenger 1898a  
 A. *nigrolineatus* Williams 1965  
 A. *ortonii* Cope 1868  
 A. *parilis* Williams 1975  
 A. *peraccae* Boulenger 1898a  
 A. *princeps* Boulenger 1898a  
 A. *proboscis* Peters and Orces-V. 1956  
 A. *punctatus boulengeri* O'Shaughnessy 1881  
 A. *trachyderma* Cope 1876b  
 A. *transversalis* Duméril in Duméril and Duméril 1851  
*Basiliscus basiliscus basiliscus* (Linnaeus 1758)  
 B. *galeritus* Duméril in Duméril and Duméril 1851  
*Enyaliooides cofanorum* Duellman 1973b  
 E. *heterolepis* (Bocourt 1874)  
 E. *laticeps laticeps* (Guichenot 1855)  
 E. 1. *festae* Peracca 1897  
 E. *microlepis* (O'Shaughnessy 1881)  
 E. *oshaughnessyi* (Boulenger 1881)  
 E. *praestabilis* (O'Shaughnessy 1881)  
*Iguana iguana iguana* (Linnaeus 1758)  
*Morunasaurus annularis* (O'Shaughnessy 1881)  
*Ophryoessoides aculeatus angulifer* Werner 1901  
 O. *erythrogaster* Hallowell 1857  
 O. *iridescent* (Günther 1859d)  
*Phenacosaurus orcesi* Lazell 1969  
*Plica plica* (Linnaeus 1758)  
 P. *umbra ochrocollaris* (Spix 1859c)  
*Polychrus femoralis* Werner 1910  
 P. *gutturosus gutturosus* Berthold 1846  
 P. g. *spurrellii* Boulenger 1914  
 P. *marmoratus* (Linnaeus 1758)  
*Stenocercus carrioni* Parker 1934a  
 S. *festae* (Peracca 1897)  
 S. *guentheri* (Boulenger 1885)  
 S. *haenschi* (Werner 1901)  
 S. *humeralis* (Günther 1859b)  
 S. *ornatus* (Gray 1845)  
 S. *rhodomelas* (Boulenger 1899b)  
 S. *simonsii* Boulenger 1899b  
 S. *varius* Boulenger 1885  
*Tropidurus occipitalis occipitalis* Peters 1871b  
 T. *peruvianus peruvianus* (Lesson 1830)  
*Uracentron flaviceps* (Guichenot 1855)

## TEIIDAE

*Alopoglossus atriventris* Duellman 1973b  
 A. *buckleyi* (O'Shaughnessy 1881)  
 A. *carinicaudatus* (Cope 1876b)  
 A. *copii* Boulenger 1885

- Alopoglossus festae* Peracca 1904  
*Ameiva ameiva* Petersii Cope 1868  
A.        *bridgesii* (Cope 1869)  
A.        *edrecantha* Bocourt 1874  
A.        *orcesi* Peters 1964b  
A.        *septemlineata* Duméril and Duméril 1851  
*Anadia petersi* Oftedal 1974  
A.        *rhombifera* (Günther 1859d)  
*Arthrosaura reticulata* (O'Shaughnessy 1881)  
*Bachia trisanale* trisanale (Cope 1868)  
*Callopistes flavipunctatus* (Duméril and Bibron 1839)  
*Dicrodon guttulatum* Duméril and Bibron 1839  
*Dracaena guianensis* Daudin 1802  
*Echinosaura horrida* horrida Boulenger 1890  
*Euspondylus guentheri* (O'Shaughnessy 1881)  
E.        *maculatus* Tschudi 1845  
E.        *ocellifer* (Werner 1901)  
*Iphisa elegans* elegans Gray 1851  
*Kentropyx altamazonicus* Cope 1876b  
K.        *calcaratus* Spix 1825  
K.        *pelviceps* Cope 1876b  
*Leposoma parietale* (Cope 1885)  
*Neusticurus cochranae* Burt and Burt 1931  
N.        *ecpleopus* Cope 1876b  
N.        *strangulatus* strangulatus (Cope 1868)  
*Pholidobolus affinis* (Peters 1862a)  
P.        *annectens* (Parker 1930)  
P.        *macbrydei* Montanucci 1973  
P.        *montium* (Peters 1862a)  
P.        *prefrontalis* Montanucci 1973  
*Prionodactylus argulus* (Peters 1862a)  
P.        *dicrus* Uzzell 1973  
P.        *manicatus* manicatus (O'Shaughnessy 1881)  
P.        *vertebralis* (O'Shaughnessy 1879)  
*Proctoporus columbianus* Andersson 1914  
P.        *hypostictus* Boulenger 1912b  
(P.        *meleagris* Boulenger 1885  
P.        *oculatus* (O'Shaughnessy 1879)  
P.        *simoterus* (O'Shaughnessy 1879)  
P.        *unicolor* (Gray 1858)  
*Ptychoglossus brevifrontalis* Boulenger 1912b  
P.        *picticeps* (Cope 1885)  
*Teuchocercus keyi* Fritts and Smith 1969a  
*Tupinambis teguixin* (Linnaeus 1758)

**AMPHISBAENIA****AMPHISBAENIDAE**

*Amphisbaena fuliginosa bassleri* Vanzolini 1951  
 A. f. *varia* Laurenti 1768

**SERPENTES****ANOMALEPIDIDAE**

*Anomalepis flavapices* Peters 1957  
*Liophlops petersi* (Boulenger 1889)

**ANILIIDAE**

*Anilius scytale scytale* (Linnaeus 1758)

**BOIDAE**

*Boa constrictor constrictor* Linnaeus 1758  
 B. c. *imperator* Daudin 1803a  
*Corallus annulatus blombergi* (Rendahl and Vestergren 1941)  
 C. a. *colombianus* (Rendahl and Vestergren 1941)  
 C. *caninus* (Linnaeus 1758)  
 C. *enydris enydris* (Linnaeus 1758)  
*Epicrates cenchria cenchria* (Linnaeus 1758)  
*Eunectes murinus murinus* (Linnaeus 1758)

**COLUBRIDAE**

*Atractus badius* (Boie 1827)  
 A. *bocourti* Boulenger 1894a  
 A. *carrioni* Parker 1930b  
 A. *collaris* Peracca 1897  
 A. *dunni* Savage 1955  
 A. *ecuadorensis* Savage 1955  
 A. *elaps* (Günther 1858)  
 A. *gaigei* Savage 1955  
 A. *lehmanni* (Boettger 1898)  
 A. *major* Boulenger 1894a  
 A. *microrhynchus* (Cope 1868)  
 A. *modestus* Boulenger 1894a  
 A. *multicinctus* (Jan in Jan and Sordelli 1865)  
 A. *occidentalis* Savage 1955  
 A. *occipitoalbus* (Jan 1862)  
 A. *paucidens* Despax 1910

- Atractus resplendens* Werner 1901  
 A. *roulei* Despax 1910  
*Chironius carinatus* (Linnaeus 1758)  
 C. *flavopictus* (Werner 1909)  
 C. *fuscus* (Linnaeus 1758)  
 C. *grandisquamis* (Peters 1868)  
 C. *multiventris* Schmidt and Walker 1943  
 C. *schlechteri* (Werner 1899)  
 C. *scurrulus* (Wagler in Spix 1824b)  
 C. *vicus* (Boulenger 1915)  
*Clelia clelia clelia* (Daudin 1803b)  
 C. *equatoriana* (Amaral 1924)  
*Coniophanes dromiciformis* (Peters 1863b)  
 C. *fissidens fissidens* (Günther 1858)  
*Dendrophidion bivittatum* (Duméril, Bibron, and Duméril 1854)  
 D. *brunneus* (Günther 1858)  
 D. *dendrophis* (Schlegel 1837)  
*Diaphoralepis wagneri* Jan 1863  
*Dipsas catesbyi* (Sentzen 1796)  
 D. *elegans* (Boulenger 1896a)  
 D. *gracilis* (Boulenger 1902b)  
 D. *indica indica* Laurenti 1768  
 D. i. *ecuadorensis* Peters 1960a  
 D. *latifasciata* (Boulenger 1913a)  
 D. *latifrontalis* (Boulenger 1905)  
 D. *oreas* (Cope 1868)  
 D. *pavonina* Schlegel 1837  
 D. *temporalis* (Werner 1901)  
 D. *variegata variegata* (Duméril, Bibron, and Duméril 1854)  
 D. v. *nicholsi* (Dunn 1933)  
 D. *vermiculata* Peters 1960a  
*Drepanoides anomalus* (Jan 1863)  
*Drymarchon corais corais* (Boie 1827)  
 D. c. *melanurus* (Duméril, Bibron, and Duméril 1854)  
*Drymobius rhombifer* (Günther 1860)  
*Drymoluber dichrous* (Peters 1863b)  
*Emmochliophis fugleri* Fritts and Smith 1969b  
*Erythrolamprus aesculapii aesculapii* (Linnaeus 1758)  
 E. *guentheri* Garman 1883  
 E. *mimus mimus* (Cope 1868)  
 E. m. *micrurus* Dunn and Bailey 1939  
*Helicops angulatus* (Linnaeus 1758)  
 H. *pastazae* Shreve 1934  
 H. *petersi* Rossman 1976  
*Imantodes cenchoa cenchoa* (Linnaeus 1758)  
 I. *inornatus* (Boulenger 1896a)  
 I. *lentiferus* (Cope 1894)  
*Lampropeltis triangulum micropholis* (Cope 1860a)  
 L. *bimaculatus lamonae* Dunn 1944  
 L. *epinephalus epinephalus* (Cope 1862b)  
 L. e. *ecuadorensis* Laurent 1949  
*Leptodeira annulata annulata* (Linnaeus 1758)

- Leptodeira septentrionalis ornata* (Bocourt 1884)  
 L. s. *larcorum* Schmidt and Walker 1943
- Leptophis ahaetulla bocourtii* Boulenger 1898a  
 L. a. *nigromarginatus* (Günther 1866)  
 L. a. *occidentalis* (Günther 1859d)  
 L. *cupreus* (Cope 1868)  
 L. *depressirostris* (Cope 1861)  
 L. *riveti* Despax 1910
- Liophis albiventris* Jan 1863b  
 L. *bimaculatus lamonae* (Dunn 1944)  
 L. *breviceps* Cope 1860a  
 L. *cobella* (Linnaeus 1758)  
 L. *epinephalus epinephalus* Cope 1862b  
 L. e. *ecuadorensis* (Laurent 1949)  
 L. *festae* (Perraca 1897)  
 L. *fraseri* Boulenger 1894a  
 L. *poecilogyrus* (Wied-Neuwied 1825)  
 L. *purpurans* (Duméril, Bibron, and Duméril 1854)  
 L. *reginae* (Linnaeus 1758)  
 L. *taeniurus* Tschudi 1845  
 L. *typhlus* (Linnaeus 1758)  
 L. *undulatus* (Wied-Neuwied 1824)
- Mastigodryas boddaerti* boddaerti (Sentzen 1796)  
 M. *pulchriceps* (Cope 1868)
- Ninia atrata* (Hallowell 1845)
- N. hudsoni* Parker 1940
- Nothopsis rugosus* Cope 1871b
- Oxybelis aeneus* (Wagler in Spix 1824b)  
 O. *argenteus* (Daudin 1803b)  
 O. *brevirostris* (Cope 1861)  
 O. *fulgidus* (Daudin 1803b)
- Oxyrhopus fitzingeri frizzelli* Schmidt and Walker 1943  
 O. *formosus* (Wied-Neuwied 1820)  
 O. *leucomelas* (Werner 1916)  
 O. *melanogenys* (Tschudi 1845)  
 O. *petola digitalis* (Reuss 1834)  
 O. p. *sebae* Duméril, Bibron, and Duméril 1854
- Philodryas elegans rufidorsatus* (Günther 1858)  
 P. *simonsii* Boulenger 1900  
 P. *viridissimus* (Linnaeus 1758)
- Pliocercus euryzonus euryzonus* Cope 1862b
- Pseudoboa coronata* Schneider 1801
- Pseustes poecilonotus polylepis* (Peters 1867)  
 P. *shropshirei* (Barbour and Amaral 1924)  
 P. *sulphureus sulphureus* (Wagler in Spix 1824b)
- Rhadinaea brevirostris* (Peters 1863b)  
 R. *decorata* (Günther 1858)  
 R. *fulviceps* Cope 1886  
 R. *lateristriga* Berthold 1859
- Rhinobothryum boallii* Andersson 1916
- Saphenophis atahuallpae* (Steindachner 1901)  
 S. *boursieri* (Jan in Jan and Sordelli 1867)

*Sibon dunni* Peters 1957b  
*S.* *nebulata nebulata* (Linnaeus 1758)  
*S.* *n.* *leucomelas* (Boulenger 1896b)  
*Siphlophis cervinus* (Laurenti 1768)  
*Spilotes pullatus pullatus* (Linnaeus 1758)  
*Stenorhina degenhardtii degenhardtii* (Berthold 1846)  
*Synophis bicolor* Peracca 1896  
*S.* *lasallei* (Niceforo-Maria 1950)  
*S.* *miops* Boulenger 1898a  
*Tantilla andinista* Wilson and Mena 1980  
*T.* *equatoriana* Wilson and Mena 1980  
*T.* *insulimontana* Wilson and Mena 1980  
*T.* *melanocephala* (Linnaeus 1758)  
*T.* *petersi* Wilson 1979  
*T.* *supracincta* Peters 1863b  
*Thamnodynastes strigilis* (Thunberg 1787)  
*Tretanorhinus taeniatus* Boulenger 1903a  
*Tripanurgos compressus* (Daudin 1803b)  
*Umbriava pygmaeus* (Cope 1868)  
*Xenodon rabdocephalus rabdocephalus* (Wied-Neuwied 1824)  
*X.* *severus* (Linnaeus 1758)  
*Xenopholis scalaris* (Wucherer 1862)

## ELAPIDAE

*Leptomicrurus narduccii* (Jan 1863b)  
*Micrurus ancoralis ancoralis* (Jan in Jan and Sordelli 1872)  
*M.* *annelatus annelatus* (Peters 1871a)  
*M.* *bocourti bocourti* (Jan in Jan and Sordelli 1872)  
*M.* *dumerilii transandinus* Schmidt 1936  
*M.* *filiformis filiformis* (Günther 1859b)  
*M.* *hemprichi ortoni* Schmidt 1953a  
*M.* *langsdorffi langsdorffi* Wagler in Spix 1824b  
*M.* *l.* *ornatissimus* (Jan 1858)  
*M.* *lemniscatus helleri* Schmidt and Schmidt 1925  
*M.* *mertensi* Schmidt 1936  
*M.* *mipartitus decussatus* (Duméril, Bibron, and Duméril 1854)  
*M.* *spixii obscurus* (Jan in Jan and Sordelli 1872)  
*M.* *steindachneri steindachneri* (Werner 1901)  
*M.* *s.* *orcesi* Roze 1967  
*M.* *s.* *petersi* Roze 1967  
*M.* *surinamensis surinamensis* (Cuvier 1817)  
*M.* *tschudii olsoni* Schmidt and Schmidt 1925

## LEPTOTYPHLOPIDAE

*Leptotyphlops amazonicus* Orejas-Miranda 1969  
*L.* *anthracinus* Bailey 1946  
*L.* *guayaquilensis* Orejas-Miranda and Peters 1970

*Leptotyphlops subcrotilla* Klauber 1939  
L. *tenella* Klauber 1939

## TROPIDOPHIDAE

*Trachyboa boulengeri* Peracca 1904  
T. *gularis* Peters 1861a  
*Tropidophis battersbyi* Laurent 1949  
T. *taczanowskyi* (Steindachner 1860)

## TYPHLOPIDAE

*Typhlops reticulatus* (Linnaeus 1758)

## VIPERIDAE

*Bothrops albocarinatus* Shreve 1934  
B. *alticolus* Parker 1934a  
B. *atrox* (Linnaeus 1758)  
B. *bilineatus smaragdinus* Hoge 1966  
B. *castelnaudi* Duméril, Bibron, and Duméril 1854  
B. *hyoprorus* Amaral 1935  
B. *lojanus* Parker 1930a  
B. *microphthalmus microphthalmus* Cope 1876b  
B. *nasutus* Bocourt 1868  
B. *pulcher* (Peters 1862e)  
B. *punctatus* (García 1896)  
B. *schlegelii* (Berthold 1846)  
B. *xanthogrammus* (Cope 1868)  
*Lachesis muta muta* (Linnaeus 1758)

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## ADDENDA

Subsequent to printing the final draft of the manuscript, I received some helpful comments from Paulo E. Vanzolini. He suggested that the following Amazonian reptiles might be part of the Ecuadorian herpetofauna:

## TESTUDINIDAE

Geochelone carbonaria

## SCINCIDAE

Mabuya bistrigata  
M.      ficta

## AMPHISBAENIDAE

Amphisbaena alba

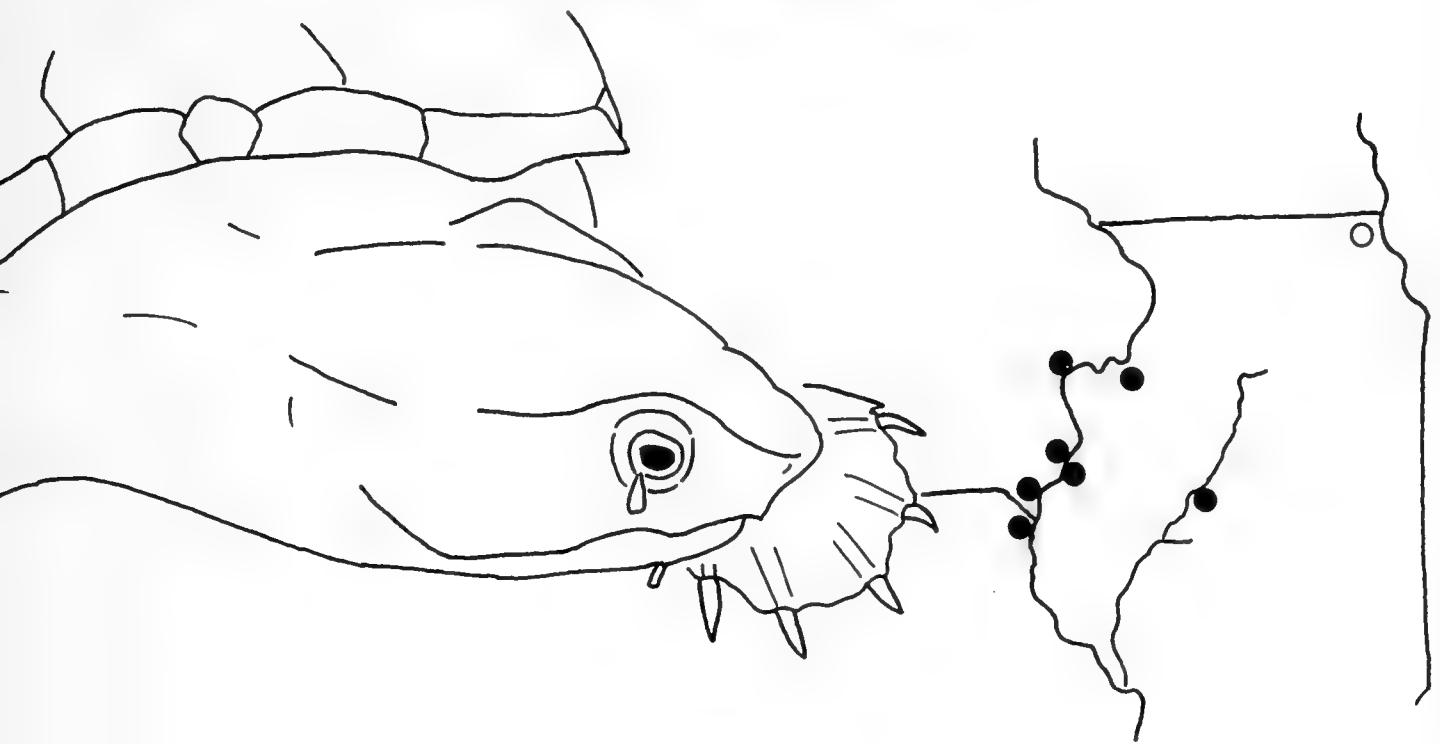
## COLUBRIDAE

Helicops leopardinus  
Hydrodynastes bicinctus  
Rhinobothryum lentiginosum  
Pseudoboa neuwiedii





A CONTROVERSY SURROUNDING AN ENDANGERED SPECIES LISTING:  
THE CASE OF THE ILLINOIS MUD TURTLE



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## INTRODUCTION

The Illinois mud turtle, Kinosternon flavescens spooneri, is a small, dark brown turtle (adults approximately 7.5-13 cm carapace length) confined to a few scattered localities in the North American Midwest. Cooper (1975) was apparently the first to publish concerns about the continued survival of the Illinois mud turtle, although James Christiansen, in a letter to the then Bureau of Sport Fisheries and Wildlife, voiced concern for survival of this subspecies in Iowa as early as 1971. Others reached similar conclusions: Moll and Brown (1976) in Illinois, Cooper (1977) in Iowa and Missouri, and Murphy and Corn (1977) in Iowa. In early 1977, Dr. Lauren Brown (Illinois State University) contacted the Office of Endangered Species of the U.S. Fish and Wildlife Service and questioned if the turtle might qualify for the U.S. List of Endangered and Threatened Wildlife and Plants. At that time, I was preparing lists of amphibians and reptiles which might be candidates for federal protection but for which little supporting data were on file. At Dr. Brown's suggestion, the Illinois mud turtle was placed on a Notice of Review of various turtles (Dodd, 1977). At the same time, Dr. Brown was requested to prepare a status report on the species. This report (Brown and Moll, 1978) summarized available information used to propose the Illinois mud turtle as an endangered species under provisions of the U.S. Endangered Species Act of 1973, as amended (Dodd, 1978). This paper summarizes the natural history, conservation activities, proposed federal listing, and controversy surrounding the proposed listing. Information on taxonomic status, population estimates, distribution, and threats have been summarized elsewhere (Dodd, ms.). The opinions expressed are those of the author and not of the U.S. Fish and Wildlife Service or Smithsonian Institution.

## NATURAL HISTORY

The following is a brief summary of the natural history and ecology of the Illinois mud turtle. Detailed accounts are in Cooper (1975), Springer and Gallaway (1979, 1980) and Kangas et al. (1980).

After reviewing the biological and physical characteristics of known habitats, Brown and Moll (1978) concluded that the Illinois mud turtle required five prerequisites for viable populations: 1) a sand substrate, 2) a sand prairie-scrub oak vegetation association of which bunch grasses, prickly pear cactus, blackjack oak, and black oak were the most important vegetational components, 3) a relatively flat topography, with low sand dunes desirable, 4) a lentic water source, that is, marsh, semi-permanent pond, or slough, and 5) the absence of human related modifications. Cooper (1975) stated that shallow permanent turbid ponds with organic bottoms were necessary; such ponds could serve as feeding areas.

In Iowa, Illinois mud turtles emerge from hibernation from late April to early May. They initially may be somewhat terrestrial, but by mid-May through mid-July, they are primarily aquatic. As summer temperatures increase and ephemeral ponds begin drying, the turtles again leave

the water and begin looking for terrestrial sites to spend the latter part of summer. At this time, turtles may move from one burrow site to another, or may burrow into the sand and remain in one location. In Iowa, Cooper (1975) observed turtles in early August, and Springer and Gallaway (1979, 1980) saw their last turtle in September, thus indicating to them that activity patterns may be bimodal. Indeed, terrestrial captures may occasionally occur throughout the summer months. Cooper (1975) caught animals on land primarily between 1500-1900 h in May and 1300-1600 h in June; the later in the season, the earlier the time of encounter as temperatures became warmer.

Kangas et al. (1980), monitoring 12 radio transmitted turtles in Missouri, also noted that turtles moved on land, although generally near water, from the time of emergence through about mid-June when they settled in one location. They reported one turtle in a marsh in September, thus also suggesting a second period of activity. Because of the long winter hibernation and summer aestivation, the Illinois mud turtle is considered fossorial, but whether it is more fossorial than other subspecies of *K. flavescens* is unknown. Mahmoud (1969) reported a roughly similar activity pattern for *K. f. flavescens* in Oklahoma although Christiansen and Dunham (1972) did not observe aestivation in New Mexico. In Iowa, there are roughly 106 days of annual activity, an extremely short amount of time for turtles (Cooper, 1975).

Upon emergence in spring, Illinois mud turtles spend considerable amounts of time basking, occurring primarily between 1100-1500 h (Cooper, 1975). As the season progresses, basking becomes less frequent until daily terrestrial activity takes on an early morning/evening and night pattern (Kangas et al., 1980).

Copulation begins in May and has been observed into July; it takes place both on land and in water (Kangas et al., 1980; Cooper, 1975). Nesting begins in mid-June. At this time, the female completely encloses herself in a subterranean nest where she lays her eggs. Smith (1961) reported clutches of 3-4, whereas Cooper (1977) estimated 2-6 and Kangas et al. (1980) 2-8 with a mean of about four. Springer and Gallaway (1979, 1980) observed two clutches, one with four eggs, the other with six, and Kangas et al. (1980) found one radio transmitted female in a nest with six eggs. Nests may be difficult to find. In spite of thorough searches, Christiansen and Haglan (1980) found no nests in the 1980 field season at Big Sand Mound.

While the age structures of the populations are unclear, especially the subadult classes, maturity is thought to occur by the 4th year in Missouri (Kangas et al., 1980) and the 5th year in Iowa (Springer and Gallaway, 1979, 1980). The sex ratio at Rose Pond, Missouri, is 1:1 (Kangas et al., 1980).

In Missouri, hatching appears to occur in early May and by June, hatchlings have arrived in the ponds (Kangas et al., 1980). Generally,

they have been caught in drift fences as they move to or from water, although they have occasionally been seined (Kangas et al., 1980; Bickham and Gallaway, 1980; Christiansen and Haglan, 1980); hatchlings are rarely otherwise encountered. Christiansen and Haglan (1980) suggested that hatchlings may overwinter in ponds in the bottom muck and debris. As might be suspected, mortality rates for hatchlings are thought to be potentially high (Bickham and Gallaway, 1980) and it is presently unknown what percentage reaches adult size. It is likely that the severity of the winter plays a significant role in survivorship of hatchlings, as it is thought to with adult survivorship. Winter kill is thought to significantly affect this subspecies (Christiansen, pers. comm.).

The Illinois mud turtle is quite adept at traveling over land for considerable distances. Kangas et al. (1980) noted that hatchlings were found as much as 600+ m from water in nearby agricultural fields. Cooper (1975) reported adults moving a maximum of 700 m and Springer and Gallaway (1979, 1980), monitoring radio transmittered turtles, gave 300-500 m from water as a general figure of distance traveled to hibernation sites; they also suggested periods of heavy rainfall may stimulate movements. Kangas et al. (1980) provided a detailed account of the movements of their 12 turtles; generally, movements also averaged several hundred meters. However, two turtles moved considerably further (3.2 and 7.7 km). The longest move was between Rose Pond and Logan's Marsh, thus indicating that turtles will move between distant ponds. Whether this was directed movement and what cues the turtle used to navigate is unknown. A displaced transmittered turtle followed by F. Moll (undated) did not orient to its capture site.

The diet of this turtle consists primarily of invertebrates, principally beetles (Coleoptera), snails, and crayfish. Fish may at times provide a major food source, especially fish trapped by drying ponds. It seems likely that this subspecies is an opportunistic feeder and scavenger. Laboratory evidence indicates that it feeds while underground in its burrows (D. Moll, 1979).

Although parasites and disease are largely unknown, Wacha and Christiansen (1976) reported parasitic protozoans from *K. flavescens* in Iowa. The light coloration of the carapace of some turtles reported by Brown and Moll (1978) at Big Sand Mound and then thought to be the result of chemical contamination is now thought to be caused by fungi (*Aspergillus* and *Penicillium*) (Springer and Gallaway, 1979, 1980). Why some turtles are susceptible to these organisms is unknown.

#### NON-FEDERAL CONSERVATION ACTIVITIES

##### Iowa-Illinois Gas and Electric Co. (IIGE).

Aside from the research activities undertaken by various scientists and graduate students in universities, the earliest conservation efforts

directed at the management of the Illinois mud turtle, and the entire Big Sand Mound ecosystem, were started by the Iowa-Illinois Gas and Electric Co. when they purchased roughly 1650 acres of land, including approximately 420 acres of the future Big Sand Mound Nature Reserve, from the DuPont Company in the mid-1970's. Prior to IIGE's purchase, the land had been leased to a hunting club which, although restricting access somewhat, provided little protection for the Big Sand Mound ecosystem. IIGE recognized the uniqueness of the area and decided to take an ecosystem approach in management and protection. Beginning in 1976, IIGE has funded yearly biological studies on the area's fauna and flora, with special emphasis on rare and endangered species. The Illinois mud turtle was singled out as a species of particular concern. It is noteworthy that research and conservation activities for the Illinois mud turtle were begun prior to state protection and subsequent proposals for federal protection.

Beginning in 1978, IIGE contracted with Drake University of Des Moines, Iowa, to monitor the biological status of organisms at Big Sand Mound for a period of five years. Periodic reports have been issued and a final summary report is expected in 1983. IIGE intends to use the results of the report, along with recommendations of the Louisa Ecological Advisory Committee, to establish a master plan for the "Sand Mound Nature Reserve." This plan is being drafted with the intention of protecting the area on a long-term basis (50 years).

In 1977, IIGE established the Louisa Ecological Advisory Committee (LEAC). The purpose of LEAC is to act as an advisory group for the management of the entire Big Sand Mound ecosystem. It is composed of 12 members representing private, county, state and federal representatives and its goals are to preserve and protect Big Sand Mound, to initiate cooperative efforts with IIGE, and to advise the company on management of the reserve. In general, LEAC meets every 6-8 weeks to review information pertaining to Big Sand Mound.

In addition to funding research, the creation of the nature reserve, and the development of LEAC, IIGE has provided strict limitations on access to the reserve. A fence was erected on the western and southern portions at a cost of \$87,000. Access is allowed only for those activities not in conflict with the purposes of the reserve. IIGE has carefully planned the development of their coal-fired power plant in ways that should minimize disturbance, and has assisted in the predator relocation and exotic plant species eradication programs. According to C. Golligher (IIGE Environmental Services Division, pers. comm.), IIGE intends to maintain its commitment to the protection of this remnant ecosystem.

#### Monsanto Agricultural Products Co.

Monsanto became involved with research efforts on K. f. spooneri after the subspecies was proposed for federal endangered status in July 1978. They hired LGL Ecological Research Associates to conduct a number

of biological studies and make recommendations for management. After reviewing available data, LGL recommended four management practices that should be undertaken immediately and, after meeting with representatives of the U.S. Fish and Wildlife Service in September 1978 to outline their proposals, Monsanto carried out the recommendations. These included the construction of a dike to control waters that "might injure the turtle or adversely alter its environment," filling a potentially hazardous mud flat, assisting in the predator removal program, and pumping 80 million gallons of water into Spring Lake to raise the water level (Anon., undated). The latter occurred only once, and Spring Lake has been dry in 1980 and 1981. In February 1981, Monsanto contacted LEAC to offer assistance in the development of the nature reserve master plan and has included approximately 115 acres in the Sand Mound Nature Reserve. Monsanto estimated that it expended in excess of \$500,000 in all phases of work dealing with research and management of the turtle and Big Sand Mound (W. D. Carpenter, statement presented at the public meeting in Springfield, Illinois, January 30, 1980).

#### State activities.

All states that contain populations of the Illinois mud turtle protect the subspecies as endangered: Illinois (January 1978), Iowa (October 1977), Missouri (January 1979).

Illinois has perhaps been most active in conservation efforts. After the Brown and Moll (1978) report appeared, the Illinois Department of Conservation (IDC) issued a contract to Michael Morris of the Illinois Natural History Survey to review the turtle's status and distribution in Illinois. The results of that survey (Morris, 1978) turned up no turtles, but provided a description of previously known localities and documented habitat loss.

Brown and Moll (1978) pinpointed management practices at Sand Ridge State Forest that might prove detrimental to *K. f. spooneri* (Dodd, ms). IDC has funded E. Moll of Eastern Illinois University to collect ecological information, including movements, habitat use, density, diet, and the impact of pine plantings, for the design of a management program. In a preliminary report (E. Moll, undated), recommendations were made to remove pine stands in the vicinity of one pond, to establish a prairie corridor between ponds A and B, to restrict the use of heavy machinery, to not transplant adults as suggested by Brown and Moll (1978) between ponds, and to continue to monitor the population. IDC has developed a management plan for the Illinois mud turtles at Sand Ridge State Forest to include these recommendations (Becker, 1980). Morris and Smith (1981) provide an overview of the status of the subspecies in Illinois in a publication put out by IDC.

In Missouri, the Department of Conservation has encouraged and supported ecological studies, especially on movements and distribution, within the state and presently administers a contract from the U.S. Fish and Wildlife Service on the species. They have provided technical assistance to individual landowners and are pursuing the opportunity to purchase part of Rose Pond, the area with the largest number of turtles. Like Missouri, the Iowa Conservation Commission is monitoring the status of the turtle and has published an article that includes information on it (Roosa, 1978).

#### PROPOSED FEDERAL ENDANGERED STATUS

The Endangered Species Act of 1973 (PL. 93-205; Stat. 884) was signed into law December 28, 1973, to "provide a means whereby the ecosystem upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section;" such conventions include, for instance, the Convention on Trade in Endangered Species of Wild Fauna and Flora. In making determinations, the Secretary of the Interior is to use "the best scientific and commercial data available...." There are two protective categories, endangered and threatened. An endangered species is one "in danger of extinction throughout all or a significant portion of its range" while a threatened species is one that "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Species, subspecies, and individual populations, except for plants and invertebrates, may be listed.

In making a determination of status, five criteria are to be used. These are: 1) the present or threatened destruction, modification, or curtailment of the species' habitat or range; 2) overutilization for commercial, sporting, scientific, or educational purposes; 3) disease or predation; 4) the inadequacy of existing regulatory mechanisms; or 5) other natural or manmade factors affecting the species' continued existence. If a species is affected by any one of these factors so as to be endangered or threatened as defined by the Act, it is a candidate for listing. Dodd (1976) has provided a general review of the Act.

In 1978, Congress passed amendments to the Endangered Species Act which substantially modified the procedures the U.S. Fish and Wildlife Service (which administers the Act in the Department of the Interior) must follow when designating "critical habitat." Section 4(f)(c) of the Act requires, to the maximum extent practicable, that any rule which determines critical habitat be accompanied by a brief description and evaluation of those activities which, in the opinion of the Director of the U.S. Fish and Wildlife Service, may adversely modify such habitat if undertaken, or may be impacted by such designation. Such activities were identified for the Illinois mud turtle as follows:

1. the development or modification of land adjoining ponds or wetlands thus leading to increased siltation or pollution of the water source,
2. the draining of ponds or wetlands known to contain this species,
3. the dumping of pollutants directly into ponds or wetlands,
4. an increased disturbance to nesting areas adjacent to ponds by humans and their pets, and
5. collection and harassment by people.

On June 6, 1977, the U.S. Fish and Wildlife Service published a notice that a review of the status of 12 species of turtles, including K. f. spooneri, was being conducted (Dodd, 1977). In response to the notice, comments were received from a number of biologists as to the precarious status of this subspecies. In addition, literature records were checked, persons familiar with the biology of the turtle were consulted, and the Brown and Moll (1978) report was carefully reviewed. As a consequence of this review, the Service proposed that the Illinois mud turtle be listed as endangered under provisions of the Act, and proposed to include areas on Big Sand Mound and in Sand Ridge State Forest as critical habitat (Dodd, 1978). Before final action could be taken on the proposal, however, Congress passed the Endangered Species Act Amendments of 1978 (PL. 95-632; 92 Stat. 3751).

On March 6, 1979, the Service withdrew all critical habitat proposals until such time as they could be repropoed in accordance with the 1978 amendments. On December 7, 1979, the Service repropoed critical habitat for the Illinois mud turtle to include an area slightly smaller than that in the original proposal for Big Sand Mound (Dodd, 1979). This revised area had been suggested by representatives of Iowa-Illinois Gas and Electric Co., LGL Ecological Research Associates, and Monsanto Inc. at a meeting with the Service in September 1978 at the Office of Endangered Species, and was based on information about land use and the movement of mud turtles on Big Sand Mound. At this meeting, the Service agreed that the suggested changes presented a more accurate delineation of critical habitat.

In conjunction with the reproposal for critical habitat, the Service held public meetings in Springfield, Illinois, on January 30, 1980, and at Muscatine, Iowa, on January 31, 1980, to explain the proposal, answer public questions, and to solicit additional information on the biology of the turtle and the economic effects of a critical habitat designation on federally authorized and funded projects in the area. No public hearings were requested on either the proposal or reproposal. All public comment periods closed on March 22, 1980.

A total of 136 comments were received in writing by the Service in response to the original proposal for endangered status and reproposal for critical habitat. Of the comments, 105 supported the proposal, including the Governors of Illinois and Missouri and the Directors of the Illinois Department of Conservation, the Iowa Conservation Commission, and the Missouri Department of Conservation, 3 opposed it, and 28 commented on some aspect of the biology of the turtle, such as its taxonomic status, distribution, or ecology, but did not state an opinion as to whether the subspecies should be added to the List of Endangered and Threatened Wildlife and Plants. A number of individuals submitted multiple comments during the course of the public comment period.

Executive Order 12044, dated March 23, 1978, required that each agency in the federal government establish criteria for identifying which of its regulations were significant. The Department of the Interior implemented this order by publishing its regulations in the Federal Register of December 13, 1978. Consequently, the U.S. Fish and Wildlife Service was required to document any impacts on state and local governments, acknowledge recordkeeping and recording burdens, document environmental considerations, discuss impacts on the other federal agencies and departmental programs, and analyze economic impacts of the reproposal of critical habitat. After reviewing all available data, including submissions by the Mason County recorder, the Southeast Iowa Area XVI Regional Commission, the Bi-State Metropolitan Planning Commission, the Iowa Department of Transportation, the Iowa Office of Planning and Programs, the U.S. Army Corps of Engineers, Iowa-Illinois Gas and Electric Co., and Monsanto Inc., the Service determined that the quantifiable economic impact was expected to fall well below \$10 million. Since this is less than the \$100 million considered as significant under departmental procedures, a "Determination of Significance" was signed on September 14, 1979, by the Assistant Secretary for Fish and Wildlife and Parks indicating that the proposed rule to determine critical habitat for the Illinois mud turtle was not a significant rule.

#### CONTROVERSY AND MISUNDERSTANDING

Given the highly visible nature of the Endangered Species Program and the many misunderstandings surrounding the determination of critical habitat, controversies involving the listing of endangered and threatened species are not uncommon. However, few proposed listings have met such opposition as the proposal to list the Illinois mud turtle as endangered. This opposition stemmed from Monsanto Agricultural Products Co., owner of about 20% of Big Sand Mound. Lipske (1980a, 1980b) provides some additional information to that presented below.

After K. f. spooneri was proposed on July 6, 1978 (Dodd, 1978), there was no indication to the U.S. Fish and Wildlife Service (FWS) of serious problems concerning the listing until July 27, 1979, when

representatives from Monsanto presented testimony at the Endangered Species Act oversight hearings for the subcommittee chaired by Congressman John Breaux. Prior to that date, Iowa-Illinois Gas and Electric Co. (in a letter dated August 23, 1978) and Monsanto (in a meeting at the Office of Endangered Species, Washington, D.C., in September) both recommended redrawing the boundaries of the proposed critical habitat to more accurately reflect the biological needs and habitat use of the turtle. As previously noted, Monsanto also outlined a series of management and research proposals suggested by their consultant, LGL Ecological Research Associates. The Service concurred with the need to slightly modify boundaries and with the management proposals as set forth.

Questions concerning data accuracy and taxonomic status were briefly raised, and the Service outlined its sources for listing and requested additional data if available. Representatives from Monsanto then presented a draft copy of Iverson's (1979) taxonomic review, stating that the data clearly showed that K. f. spooneri was not valid; in fact, this was in direct contrast to the conclusions of the paper. Two important points were made clear to Monsanto at the meeting: 1) that there were more data used in the proposal than sole reliance on the Brown and Moll (1978) report, and 2) that to qualify for listing, species, subspecies, or populations were eligible. Thus, taxonomic status might be an interesting biological problem if questions had been raised prior to proposal, but taxonomic uncertainty is not necessarily a weakness in a proposal, such that it should be invalidated. Disjunct populations of the American crocodile (Crocodylus acutus) and Pine Barrens treefrog (Hyla andersonii) had previously been listed under provisions of the Act.

In the Congressional oversight hearings, Monsanto severely criticized the U.S. Fish and Wildlife Service, claiming that documents used in the proposal were unscientific and full of suppositions, innuendoes, and speculation. It called the proposal "deplorable." In addition, Monsanto claimed that their proposals to change boundary lines, reports of work already completed, and their management recommendations, never were acknowledged. Such was not the case. Monsanto concluded their testimony, "It would appear that there should be some way to spend our resources on those problems that are worthy of immediate and long-range solution; the most important ones; and not expend our resources on some fringe matters." The conservation of K. f. spooneri was clearly perceived as a fringe matter.

A letter dated November 14, 1979, from Earl C. Spurrier, Director of Government Relations for Monsanto, to Hubert L. Harris, U.S. Assistant Director for Congressional Relations, gives the earliest indication that the results of the research of Monsanto's consultants may have been anticipated, in spite of the fact that the data were then not fully analyzed (letter dated February 29, 1980, from B. Gallaway, LGL, to Harold J. O'Connor, Acting Associate Director - Federal Assistance, U.S. Fish and Wildlife Service). In this letter, Mr. Spurrier states:

"In fact, the accumulation of 'scientific evidence' was so sparse and unsupportable that Monsanto undertook, with great financial expense, to create a truly scientific research program. This was done to study not only the habitat of the turtle, but also to observe the migratory and living habits of the turtle. Further, to determine if this turtle had any genetic relatives in other parts of the country, chemical determinations and other scientific evaluations were conducted on specimens of the turtles to further identify generic similarities or dissimilarities.

A very complete research report is being prepared for Monsanto which should give us a real indication as to true facts in the case.

Hugh, when we have our complete report, because of your personal interest, I will see to it that you have access to the information as I believe there may be other proposed species on the endangered list that have been placed there with insufficient data to support such a proposal."

Monsanto made a substantial number of contacts to local officials in Iowa and Illinois and the U.S. Senators and Representatives making similar statements and implying that the U.S. Fish and Wildlife Service was ignoring scientific data (an example is a letter dated January 16, 1980, to U.S. Senate staffer Clarence Thomas). By mid-January 1980, the Service had received a number of letters from U.S. Congressmen, including Senators John Culver (Iowa) and John Danforth (Missouri), and Representative J. Leach (Iowa), questioning FWS' activities with regard to the Illinois mud turtle. Danforth chided the Service for its "apparently shabby treatment" of Monsanto and stated that Monsanto had informed him that they had made available to FWS data which "refuted" the conclusions of the study on which the listing proposal was based. On February 4, 1980, Senator R. Jepsen (Iowa) met with then Interior Department Secretary Cecil Andrus in an attempt to dissuade the Department from proceeding with the listing.

Prior to October 1979, biologists at the Office of Endangered Species (OES) had received bi-weekly synopses of Monsanto's contractees work, but these reports represented raw unanalyzed data. They were examined as they were received and filed, but since a final report was due in October which would summarize all work, no decisions were made concerning future listing activities. No final report was received by FWS until January 1980.

The question of the timing of LGL's final report eventually became the focus of much misunderstanding. The following chronology is taken from a letter dated February 29, 1980, from B. Gallaway of LGL to Harold J. O'Connor of FWS. The first draft of the report detailing the results of

the distributional surveys and ecological work was completed in mid-November 1979. This draft was distributed without covers, abstract, color plates, or appendices to Monsanto and individuals who had been involved in the studies for LGL and was reviewed during the remainder of November and December. According to Gallaway, this draft contained no taxonomic conclusions as data analysis had not been completed. The completed report was expected to be available in late January. John Bickham was not even supposed to begin morphometric analysis until mid-December with completion expected the first week in January.

Unexpectedly however, LGL was requested to present its findings at the January 7 meeting of the Louisa Ecological Advisory Committee. Inasmuch as Bickham had just completed his preliminary analyses in late December, the final report was rewritten to include Bickham's conclusions but without any of his supporting data. This report was bound in pre-printed covers dated November 1979 and distributed at the January 7 meeting of LEAC (Springer and Gallaway, 1979). According to Gallaway, the report had still not been reviewed completely by LGL; therefore, the word "final" was scratched out and replaced by "draft." Representatives of an FWS regional office attended the meeting and the copy they received was indeed marked "draft." Thus, no one who attended the meeting expected this to be LGL's final report and thus available for public review and circulation. Gallaway expected a final version dated January to be ready for the public meetings on the proposal scheduled for January 30-31 (Springer and Gallaway, 1980). Monsanto received their copy January 6, 1980.

The FWS regional office contacted the Office of Endangered Species and notified them that a draft final report on LGL's work had been received at the LEAC meeting and requested whether it should be forwarded to Washington. They were told that since the true final report would be available at the public meeting and since there was no urgency to review the data, it would be acceptable to wait for the final report.

By mid-January, FWS began receiving letters and inquiries from U.S. Congressmen requesting an explanation as to why FWS was pursuing the proposal in light of the extensive work that had been funded by Monsanto which purported to show that the turtle was widespread and not even a valid subspecies. The FWS responded that only bi-weekly progress reports had been received by the Washington Office and requested clarification as to which data were being ignored. On January 11, a copy of Springer and Gallaway (1979) was given to FWS by staff members of the Senate Environment and Public Works Committee where it had been used as evidence of FWS' refusal to withdraw the proposal in spite of overwhelming evidence to the contrary. This copy, also dated November 1979, did not have the word "final" scratched out, thus giving a false impression about the contents and implying that FWS had had the results for over two months.

Fearing that the credibility of FWS had been compromised, it was decided to send the report to nine turtle specialists for evaluation.

Peer review of reports is often utilized by FWS, although it is by no means mandatory. All respondents severely criticized the many conclusions with little or no supporting data. Thus, at the public meetings in late January, FWS representatives were disturbed at the way the report of Springer and Gallaway (1979) had been used against the listing; at the same time, LGL was disturbed that FWS had sent their draft report to specialists when it had thought clear that FWS knew the report preliminary. FWS was not aware that LGL knew nothing of the circulation of its report marked "final." And since the report had been put to Congressmen as a final report which should be used as evidence of FWS incompetency, FWS felt obligated to have the report strictly scrutinized. Thus developed an aura of hard feelings between FWS and LGL.

In February and March, Monsanto continued to lobby to have the listing withdrawn. In a letter dated March 3, 1980, Monsanto submitted extensive comments to FWS in which they reiterated their position that the turtle did not warrant federal protection. They again took a point by point issue with nearly every statement in Brown and Moll (1978) concerning Big Sand Mound and praised the LGL work, but this time devoted extensive criticism of John Iverson's and OES' objectivity and credibility. The letter also stated that electrophoretic work involving analyses of proteins of heart, liver, kidney, and eye tissues had been investigated although the results were not completely analyzed. This letter is interesting because it first broaches the idea of an independent review panel. The letter states:

"Further, we are concerned about the disparity of treatment given LGL's Final Report as opposed to the status report prepared by Drs. Brown and Moll. We think it only fair that LGL's Final Report, together with the addendum and supportive data being supplied to the Service, be submitted to a blue-ribbon panel of disinterested scientists for critical evaluation. This same panel should also critically review the status report and the data Drs. Brown and Moll submitted to support the conclusions contained therein. We are prepared to accept the decision of that panel as to what constitutes the 'best scientific data' available as required by Section 4(b)(1) of the Endangered Species Act of 1973, as amended."

On March 6, 1980, representatives of FWS and LGL met to discuss the morphometric work conducted by John Bickham and his students. Copies of the report on the taxonomic work (Bickham and Gallaway, 1980) were submitted for the administrative record; this report only contained morphometric and karyological results.

Iowa-Illinois Gas and Electric Co., owner of 80% of Big Sand Mound, had been relatively neutral concerning the proposal and resulting controversy. On March 7, they submitted additional comments in which they

stated that they did not think listing would benefit *K. f. spooneri* anymore than the protection it was already afforded on Big Sand Mound by IIGE. IIGE said that they would maintain the area as protected but feared additional regulatory burden. Areas outside Big Sand Mound were never addressed in IIGE submittals.

Evidence of lobbying continued. On March 13, James D. Webb, Deputy Assistant Secretary for Fish and Wildlife and Parks, informed the Director of FWS that the Congressional Office of Management and Budget, the agency responsible for the budgets of federal programs including the Endangered Species Program, had decided to make a "case study" of the proposed listing of the Illinois mud turtle to determine if proper compliance with Executive Order 12044 had been adhered to, the first such request ever received by FWS. Accordingly, a briefing statement dated March 19 was prepared by FWS; no irregularities or errors were found as a result of this review.

On March 19, a Freedom of Information Act request was filed with FWS by U.S. Senator Orrin Hatch, a close associate of Senator R. Jepsen. Subsequently, an aide from Senator Hatch's office visited the Office of Endangered Species of FWS to review all data, but could find no improprieties in FWS procedures or analysis of data (J. Black, pers. comm.). Senator Jepsen furnished a letter to Monsanto from Cecil Andrus, Secretary of the Interior, in response to his inquiries, which prompted another long letter from Monsanto dated March 25 in which essentially the same topics were discussed as in their March 3 letter.

When Congress passed the Endangered Species Act Amendments in 1978, it specified that a two year deadline be imposed on all proposals to list species as endangered or threatened. Consequently, the date July 7, 1980, assumed special importance to the Illinois mud turtle since the subspecies would have to be listed or withdrawn by that date. By March 22, 1980, however, all public comment periods, which had been specifically reopened at Monsanto's request to allow submission of LGL's and Rickham's final results, were closed. After extensive review by biologists both within and outside the Office of Endangered Species, it was decided that the Illinois mud turtle should be listed as an endangered species with the critical habitat modified as requested by industry. By this time, the population in Clark county, Missouri, had been discovered. However, because of the two year deadline imposed by Congress, it would have been impossible to propose this area as critical habitat in connection with the listing. Therefore, it was decided to propose this area at a later date after listing. This course of action was recommended to the State of Missouri, who concurred (T. Johnson, pers. comm.). By April 29, 1980, the final rule had been approved by the Office of Endangered Species.

Unbeknownst to biologists in OES, however, on April 15, 1980, Lynn Greenwalt, then Director of FWS, wrote a letter to Chester O. McCorkle, Jr.

of the National Academy of Sciences to request the assistance of the Academy in resolving the dispute. This course of action was recommended by Congressman John Breaux and first raised in Monsanto's letter of March 3. The Academy responded that it did not have sufficient time to set up such a panel, but recommended a number of turtle biologists and statisticians that would be qualified to serve. Thus the panel was not endorsed by the National Academy of Sciences, nor did it contain any Academy members.

On June 5-6, 1980, the panel was convened by FWS at the Patuxent Wildlife Research Center under the auspices of David Trauger, Chief of FWS' Wildlife Ecology Research Division. Trauger had no prior experience with the events surrounding the administrative record regarding K. f. spooneri, nor did he review any data in the files of OES. No one from OES was invited to the meeting to present information regarding the listing although the question was raised by one panel member (C. Ernst, pers. comm.). The panel consisted of the following members: James F. Berry, James L. Christiansen, Carl Ernst, J. Whitfield Gibbons, Paul N. Hinz, and John B. Iverson.

The panel was given five questions to respond to, including:

1. Were the survey procedures used by the parties furnishing information to the Fish and Wildlife Service on the proposed listing of the Illinois mud turtle accepted techniques and correctly conducted: Were they statistically valid?
2. Were the procedures utilized (such as electrophoresis) to determine the taxonomic status of the Illinois mud turtle valid for use on these turtles, and was the analysis of data from these procedures reasonable?
3. Does the information and analysis suggest that Kinosternon flavescens spooneri is a distinct subspecies?
4. Is it correct to assume in those cases where surveys found only a few turtles that sizeable populations were present under the water or under the ground?
5. Does analysis of the data imply that the Illinois mud turtle is a declining subspecies or population, a stable subspecies or population, or an increasing subspecies or population? Can any projection be made in regard to the total number of individuals in such subspecies or populations?

A final report was typed and signed by all members (Berry et al., 1980). It concluded, in part, that: 1) there was no attempt "to estimate the total population of Illinois mud turtles based on a statistically valid survey of Illinois mud turtle habitat" although estimates in areas

thoroughly sampled were conducted properly to derive population estimates; 2) the morphological analysis of LGL was reasonable and appropriate; 3) there had not been enough evidence presented to invalidate the trinomen *K. f. spooneri*; 4) it is possible to assume that more turtles may be indicated as present at a site on the basis of a few observed specimens; and 5) it is impossible to document a declining population although habitat alteration is a problem. The panel emphasized that the number of good habitats and their quality was declining. Three additional important recommendations were made:

- "1) In view of the present rates of habitat destruction and the population status of the Illinois Mud Turtle, there is a need for protection of this subspecies, especially the populations in Illinois.
- 2) Careful consideration of the most appropriate and effective strategies for protecting the Illinois Mud Turtle should be made at the local, state and/or federal levels. There exist several private and local efforts on behalf of this subspecies to serve as models.
- 3) There is a need for additional research to clarify the remaining questions concerning the taxonomic and population status of the Illinois Mud Turtle."

On June 11, 1980, a memorandum written by Trauger but signed by Richard N. Smith, Associate Director - Research, FWS, concluded:

"Based on the report of the Review Panel, insufficient information is available on the Illinois Mud Turtle to justify listing it as a threatened or endangered species by the U.S. Fish and Wildlife Service at this time. There is a need to conduct further research to clarify the complex taxonomic relationship and to estimate the total population of this subspecies. The Illinois Mud Turtle is considerably more abundant and widely distributed than previously thought. Local and private efforts should be encouraged to promote its conservation and to protect its habitat. The Panel favored this strategy as the one most likely to succeed."

This recommendation caused Director Greenwalt to withdraw the final rule which had been waiting in FWS' Solicitors office pending a decision. A notice withdrawing *K. f. spooneri* from consideration as a candidate for endangered status was published August 14, 1980, (Opler, 1980), 38 days after the proposal would have been withdrawn because of failure to comply with the Amendments of 1978. Biologists at OES refused to approve the withdrawal notice; indeed, a complete point by point refutation of Smith's June 11 memorandum was sent to the Director on June 19, 1980, but was ignored.

Prior to the withdrawal notice, IIGE had been informed of the panel's meeting only by rumor and that it was, indeed, a National Academy of Sciences panel (letter to FWS dated June 11, 1980). They expressed concern since "various reports have labeled the selection of the panel members as biased."

A number of scientists and conservationists took strong issue with the FWS' decision to withdraw the listing. However, FWS maintained almost verbatim the reasons outlined in Smith's June 11 memorandum although they did not represent the opinions of the panel (J. Berry, J. Christiansen, C. Ernst, J. Iverson, pers. comm.). In a letter dated July 11, 1980, to L. Regenstein, FWS conveyed the reasons for the panel's deliberations ("...there are those who questioned our ability to render an impartial decision concerning the listing of this species."). Only Monsanto questioned the objectivity of the FWS throughout the two years of deliberation.

After the withdrawal notice, the Illinois mud turtle question subsided since it was clear that the subspecies' would not be listed formally as endangered. However, on December 8, 1981, at the oversight hearings on the reauthorization of the Endangered Species Act before the U.S. Senate Environment and Public Works Committee, S. Boynton, in criticizing the Act, again chastised the U.S. Fish and Wildlife Service for its proposal of the Illinois mud turtle 3 1/2 years previous, stating that "those responsible in the Office of Endangered Species had not done a credible job...." In a letter dated January 8, 1982, Mr. Boynton again stated that there were insufficient data to support the original proposal; reviewed Monsanto's management plan; restated the unreviewed findings of LGL, including allegations that electrophoretic work conclusively demonstrated that *K. f. spooneri* was not a subspecies and that the results had been published in "key scientific journals;" and that a panel of the National Academy of Sciences stated that the information on which FWS based its original proposal was weak and inadequate, thus indicating an "indictment" of FWS. This information was taken from a booklet published by Monsanto (Anon., undated), a copy of which he supplied to the Committee. In a letter dated January 8, 1982, to Senator John Chafee, Chairman of the Committee, E. C. Spurrier of Monsanto stated that Mr. Boynton's testimony was "a statement of the facts." The controversy continues.

#### DISCUSSION AND CONCLUSIONS

There is a current feeling within certain segments of industry that environmental regulations are a luxury in a society facing economic problems. As such, any regulation that is deemed to provide stricter oversight of company activities is automatically opposed. Such is perhaps the case with Monsanto and the proposed listing of the Illinois mud turtle although it is impossible to ascertain motives. Certainly, the listing of the subspecies would not have seriously affected the operations of the Muscatine plant. FWS directed repeated inquiries to Monsanto requesting specific economic impacts but Monsanto only responded by indicating additional review would

be required of an already large number of permits. A list of these permits was requested in the hopes of quantifying economic burden, but careful review revealed that none would have been impacted by the determination of critical habitat.

The significance of the controversy surrounding the proposal to list *K. f. spooneri* does not involve the failure to list one particular subspecies in need of protection. Instead, it involves the recognition of the precarious nature and foundation of laws designed to protect and preserve genetic diversity on a species by species approach. The Endangered Species Act of 1973 is a laudatory attempt to balance societal values with the tendency to view "non-significant" plants and animals as undeserving of much attention. However, by focusing attention on individual species, the ecosystems on which they depend, so dramatically emphasized in the purposes section of the Act, are ignored or at least overlooked.

The sand prairie, exemplified by the assemblage of plants and animals at Big Sand Mound, is indeed a unique ecosystem fast disappearing in the face of modern agricultural practices. As such, it is this ecosystem that is worth protecting, not just the Illinois mud turtle which depends on it. During the extensive deliberations between industry and the government, this idea seems to have been overlooked.

Almost the entire controversy focused on one particular area, Big Sand Mound, and indeed, only on 20% of Big Sand Mound. Regardless of motivations, this emphasis shifted focus from habitats containing far fewer numbers of turtles which are imminently threatened with modification. Unless attempts are made soon to halt this destruction, these island ecosystems will be lost. Methods for protection could include outright purchase, as the State of Missouri is contemplating at Rose Pond, cooperative management agreements between landowners and state and private conservation agencies such as The Nature Conservancy, tax incentives for not destroying wetland habitats, and education as to their importance. State and private agencies are free to pursue these goals without listing by the federal government, but additional incentive and priority would have been provided by doing so.

The controversy involving Big Sand Mound not only slighted the biological aspects of listing an endangered species, but also slighted another company's efforts on behalf of an ecosystem approach to management of unique areas. In all the press releases, newspaper and magazine articles (for instance, Berman, 1981), and testimony presented before the various committees of the U.S. Congress, the only company ever mentioned in Monsanto. This is in spite of the fact that Iowa-Illinois Gas and Electric Co. became involved in the conservation of Big Sand Mound, both by declaring it a reserve and by funding numerous biological studies, as soon as they had purchased the area and prior to any state or federal concern for the Illinois mud turtle. This commitment continues even though the subspecies has been withdrawn from consideration. To hear

testimony before Congress, Monsanto is the only company on Big Sand Mound, even though Spring Lake, nearly entirely on Monsanto property, has been dry the last two years.

Not only has IIGE been slighted, but state activities as well. Both Illinois and Missouri have undertaken aggressive research and/or management programs for the subspecies without federal prodding, although in some cases with federal money. In light of cutbacks in the federal Endangered Species Program, no further financial assistance can be offered to the states for the conservation of this federally unlisted subspecies. However, states have continued to protect K. f. spooneri as endangered and may be expected to continue their efforts within budgetary restraints.

There is a serious question regarding professional ethics in the Illinois mud turtle controversy. Data misrepresentation, omission, or overstatement has no place in scientific circles. As such, the peer review system is designed to insure accuracy and competence of data and its interpretation. All publications used by FWS in proposing the Illinois mud turtle were submitted to peer review and published by reputable journals prior to the decision in early 1980 to proceed with listing. On the contrary, all reports opposing listing, admittedly with LGL's qualifications concerning data analysis, were severely criticized by the majority of reviewers. Indeed, only one paper has been submitted and accepted for publication (Houseal et al., 1982), thus refuting the claim (Anon., undated) that the results of their funded studies have been published "in key scientific journals."

This is not to imply that LGL or its contractees in any way improperly collected or interpreted data during their studies; there is no indication that anyone involved was pressured to conform to a preconceived policy. However, it does mean that extreme care must be used whenever one's name is on a report or paper to insure that the contents are not misused, as was done with Springer and Gallaway (1979). In the long run, scientific validity will be determined by the review of other scientists of published data, but in the meantime, reputations may be marred which could be of much more importance. The implication of a National Academy of Science endorsement is unethical. Whether the Academy is aware of this is unknown.

The role of FWS throughout the Illinois mud turtle controversy must be questioned. Until late 1979, there was no indication to the Office of Endangered Species that the listing should be expected to encounter problems within the Department of the Interior, even though there had already been a number of contacts between Monsanto and the Director of FWS' office. When lobbying increased and in spite of biological data to the contrary, the Service stalled the listing focusing on the false issue of taxonomy until a panel could be convened. FWS then requested that the panel take up five ambiguous questions instead of reviewing all biological data, and not make additional comments or recommendations.

When the panel convened, no one from OES was allowed to attend to present the administrative and biological record. A memorandum from a FWS individual not having experience with turtles or their biology was used by the Director to stop listing, even though the memorandum misrepresented the panel's conclusions and ignored an extensive amount of biological data. As a result, FWS' credibility took a severe blow in the scientific community among those familiar with the data.

The Illinois mud turtle today is endangered by habitat alteration as recognized in the original proposal of 1978, as well as the decreasing water table levels which have become more of a problem since then (Dodd, ms.). It is not likely that listing under provisions of the Act would automatically have reversed this apparent decline, but it would have allowed strong federal protection, including the development of a recovery plan with some federal money, to supplement state and private conservation activities. Illinois, Missouri and IIGE are to be commended for their continuing involvement and commitment towards the subspecies' conservation. However, in spite of these efforts, the habitat and the turtle are in trouble. Unless suitable areas can be preserved, individual Illinois mud turtles may persist for many years, yet their fate will have been decided. As the largest population, Big Sand Mound must be preserved in perpetuity, for as C. Golligher of IIGE has noted (in a letter to FWS dated November 4, 1981), the policies of companies can change according to future needs and demands. Only long term protection can be expected to be effective.

In the Illinois mud turtle controversy, no one benefited, least of all K. f. spooneri.

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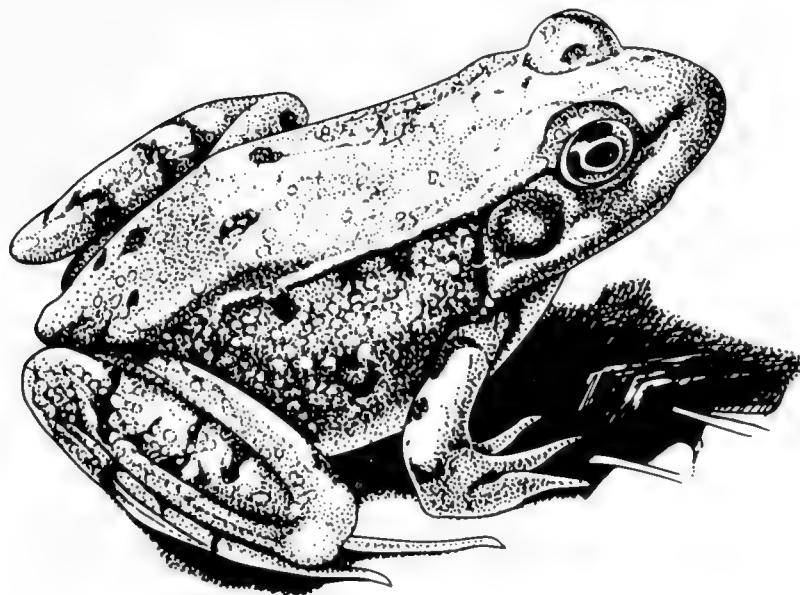




A BIBLIOGRAPHY OF THE GREEN FROG,

PANA CLAMITANS LATREILLE

1801-1981



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## INTRODUCTION

Rana clamitans, the green frog, is one of the most abundant and widespread ranids in North America. It occurs throughout eastern North America from central Florida to 50° N Latitude in Canada. The literature concerning the species, described in 1801, is vast. With the help of numerous persons, we have attempted to compile a complete bibliography, through 1981, of publications concerning the green frog. We have listed papers and notes containing substantive information about the species, including range records. Papers that only mentioned other references already included are omitted. Although all references have not been checked, we included them if the source were reliable. Many standard field guides and keys for identification that include R. clamitans appear in the "General" section.

We searched Zoological Record, Biological Abstracts, Wildlife Review and indices of Copeia, Herpetologica, Journal of Herpetology, the American Midland Naturalist, Herpetological Review and numerous other references. We realize that there are omissions, especially to older papers, locality records, and notes that are not included in standard bibliographic sources. We appreciate obtaining from readers any omitted references which we shall compile as an addendum at a later date.

Readers looking for topical references should examine all related subject categories since decisions of where to place a particular reference must sometimes be arbitrary. Without becoming too cumbersome, we have cross-referenced other appropriate entries concerning each subject.

This project was undertaken by the senior author in connection with writing the Rana clamitans species account for the Catalogue of American Amphibians and Reptiles. Numerous persons have assisted with references and information concerning the species, and we thank them for their generous contributions of time and information. Providing distribution records and loan of material from their institutions were: E.R. Brygoo and Jean Lescure, Museum National d'Histoire Naturalle, Paris; F.R. Cook, National Museum of Canada; E.J. Crossman, Royal Ontario Museum; J.R. Harrison, III and A.E. Sanders, The Charleston Museum; A.J. Kluge, University of Michigan Museum of Zoology; H. Marx and H. Voris, Field Museum of Natural History; C.J. McCoy, Carnegie Museum of Natural History; M.A. Nickerson, Milwaukee Public Museum; W.M. Palmer, North Carolina State Museum of Natural History; E.R. Reilly, New York State Museum; G.R. Zug, National Museum of Natural History; and R.G. Zweifel, The American Museum of Natural History. Others providing information were Kraig Adler, the late J.D. Anderson, Stephen D. Busack, Charles J. Chantell, Nick Drahos, Robert Dorrance, Carl Gans, F.R. Gehlbach, K.E. Goellner, J.Alan Holman, Mike Shepard, Barbara Pytel, and Kentwood Wells. We are grateful for their kind assistance.

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The cover illustration is a drawing of a pale bicolor Rana clamitans from Woosh Pond, Cranberry Lake, New York, drawn by Ryland Loos from a color transparency by M.M. Stewart and reproduced by Robert Speck.

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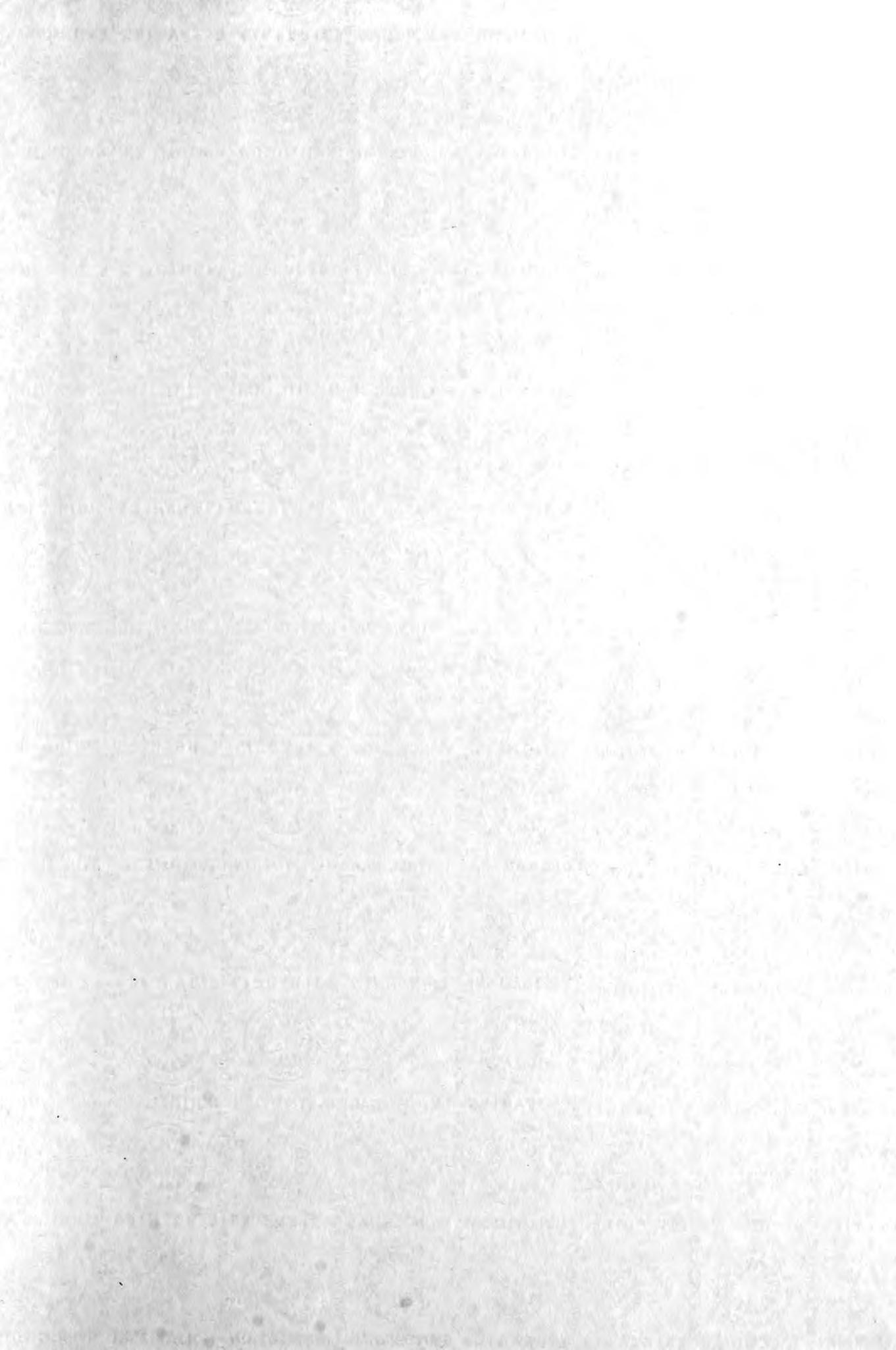


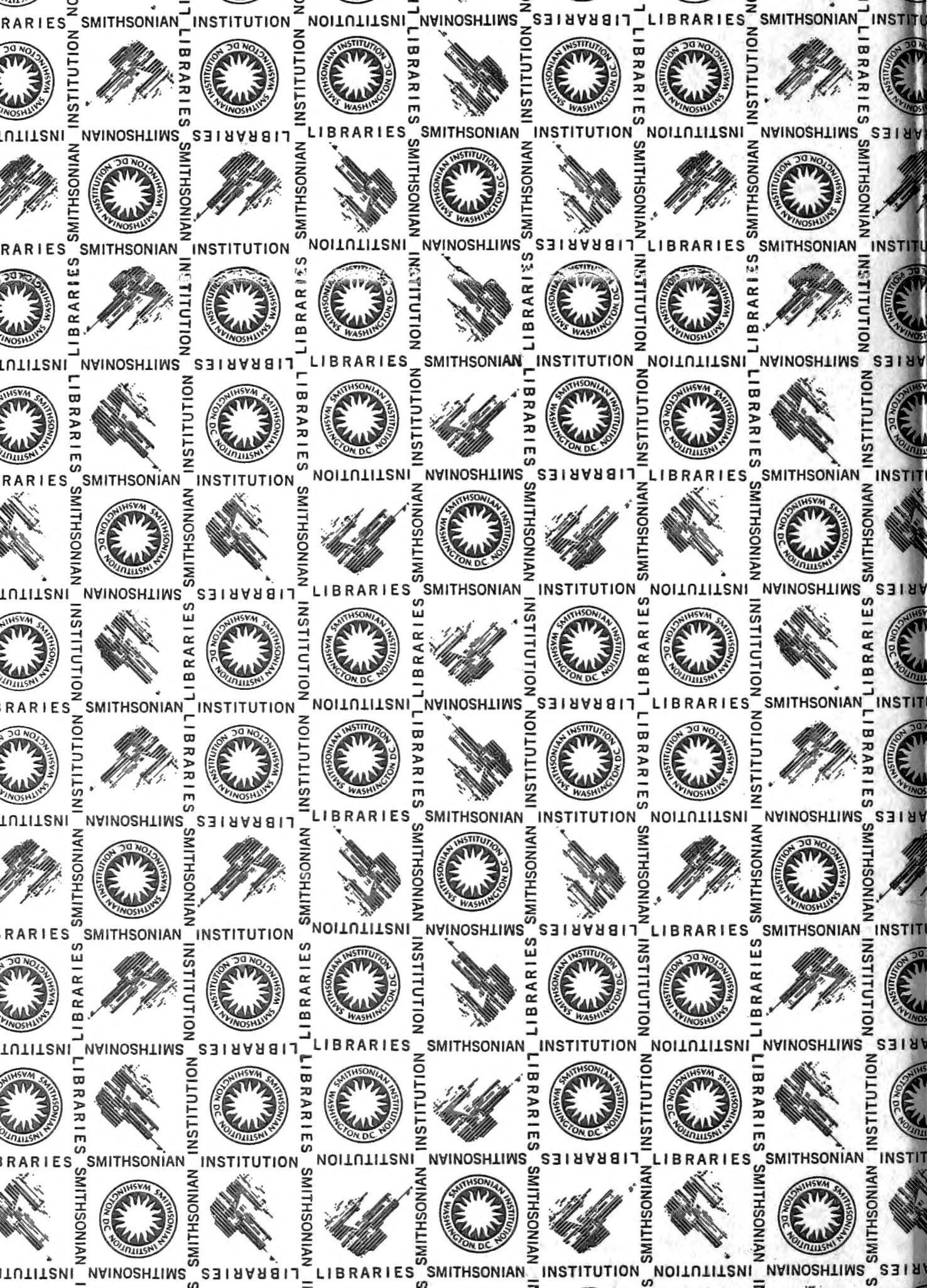


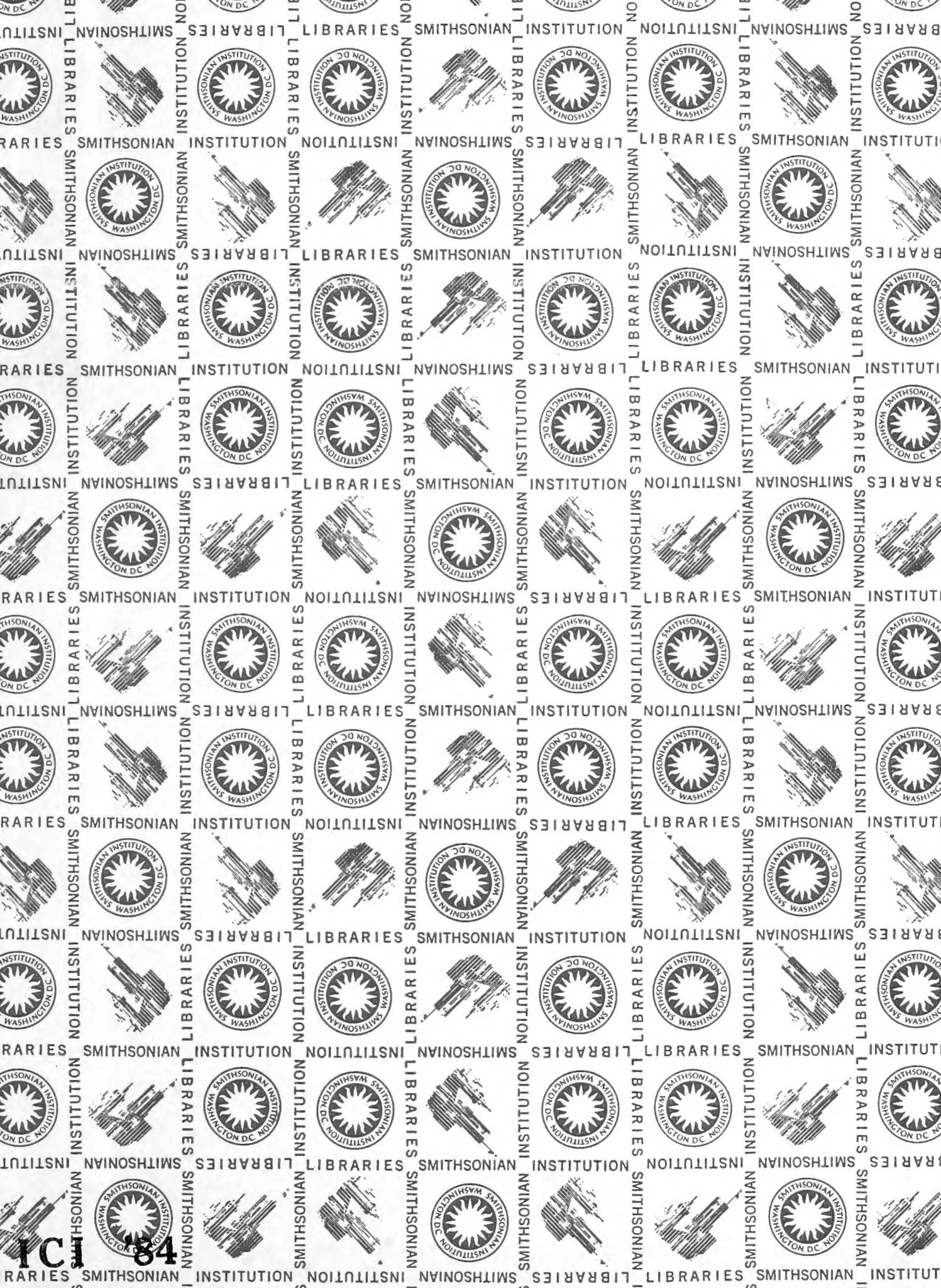
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